Engineering Record

A Weekly Journal Devoted to Civil Engineering and Contracting

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Engineering Record and Engineering News Consolidate

Engineering Record and Engineering News will be consolidated April 5th as the Engineering News-Record

WE FIND it hard in making this announcement to refrain from the use of superlatives. Both papers have had such remarkable careers, both have built up such strong clienteles, both have to their credit so many achievements, that the imagination is fired at the thought of what they are capable of doing when their prestige, their staffs, their energies are combined.

For years both have been developing rapidly, and as they developed, their conceptions of the journalistic needs of the civil engineer and the contractor have come closer together and are now practically identical. Consequently, there has been much duplication—in material published and in the organizations to produce the papers. Moreover, each paper has excelled in certain special fields, due to the abilities of the specialists on the respective staffs.

Now it is proposed to give the readers under one cover the strong features of both papers and to turn the duplicated efforts into productive lines. Mr. Charles Whiting Baker, for twenty-one years editor of Engineering News, will be editor-in-chief, while Mr. E. J. Mehren, editor of the Engineering Record, will become vice-president and general manager of the McGraw-Hill Publishing Company, Inc., which has been organized to take over the ten publications of the McGraw Publishing Company, Inc., and of the Hill Publishing Company.

We bespeak for the new journal the same hearty support that has been accorded to the two constituent papers, and on behalf of the editors we pledge a service to the civil engineer and the contractor entirely unprecedented in technical journalism. And we give this pledge with the greater confidence because our publishing experience tells us that never before has there been brought together so able and brilliant a staff as that which will man the new journal.

JAMES H. McGRAW
President, McGRAW PUBLISHING COMPANY, INC.

ARTHUR J. BALDWIN
President, HILL PUBLISHING COMPANY

Engineering News-Record Consolidation

THE IMPORTANCE of the announcement on the preceding page, of the consolidation of the Engineering Record and Engineering News, need not be emphasized for the readers of this journal. The two papers have for so long been the leaders in their field, have played so great a part in the development of the civil engineering art that the event is of first importance to all civil engineers and contractors.

While the step is momentous, it comes logically. For years, Engineering News covered broadly the whole field of engineering, while the Engineering Record, until as late as five years ago, devoted much space to heating, ventilating and power plants for buildings. Both journals have found it necessary in recent years to confine themselves to civil engineering and contracting. Moreover, their analyses, made independently, of what the civil engineer and the contractor want have led to the same conclusions. As a result, what differences there were in editorial policy have almost wholly disappeared. There has been much duplication in material and in the machinery for gathering data from the engineering field. Then again, the staffs have developed strength in certain directions: In some specialties Engineering News has excelled, in others the Engineering Record.

By combining the two papers the waste will be stopped, the efforts now spent in duplicate service will be turned into original lines and there will be put into one magazine all the strength which the specialists on either staff have contributed to their respective papers. *The result will be a service to the engineer and the contractor which neither paper alone could furnish.*

Both papers have had plans for expansion in certain directions, for more intensive specialization in others. Financial limitations prevented these plans from being put into effect in all their fullness. Now, with the strength derived from the consolidation, the editors can go forward with speed in the development of these plans. *Their ideal is nothing short of a paper that will fill every need that can be legitimately served by a technical journal.*

The editors are not unmindful of the tremendous responsibility which the publication of such a journal will impose. With a circulation of approximately 35,000 they will reach each week between 75,000 and 100,000 civil engineers and contractors. To be allowed to speak to them weekly, to present analyses of important developments, to give them broad views on public questions, to fight their battles, to lead ever upward, to hearten them in their efforts to develop a professional consciousness, is a great privilege. At the same time this very privilege, this opportunity, imposes the grave responsibility of being ever on the alert to sense first and to record matters of importance to the profession, and of looking fearlessly at all situations, championing what is best for the engineer and the contractor, no matter what the cost.

We cannot close these comments without expressing to you, the readers of the Engineering Record, our thanks for your support and our confidence in your continued interest. You have been most kind to us during our period of developing the Engineering Record. You have commended the changes which you believed were for the better. You have constructively criticised when our course did not meet your approval.

Soon, the Engineering Record's career of forty years as a separate journal will close. We who have lived our lives into it would witness its going with regret did we not realize the brighter future ahead. We see it, consolidated with Engineering News, rendering a still greater service to the field, striking more telling blows for the advancement of its clientele and for the public good. We know, too, that its spirit—the spirit of optimism, of faith in the ultimate leadership of the engineering profession—will not pass, but will be more striking, more virile in the larger paper.

The Engineering Record is not to die. It is to enter on a greater career.

Michigan's Motor-Truck Bill

THE bill "to regulate the operation and use of vehicles on the highways," now before the Michigan legislature and summarized by D. A. Thomas on page 343 of this issue, is unusual, as compared with similar measures in other states, in that it does not single out the motor truck as the sole agency responsible for damage to roads. Among the offenders it recognizes the horse-drawn vehicle. Whether it will pass in its present form remains to be seen. Any measure which carries with it even a hint of alienating the farmer vote can generally be counted upon to create panic among the Solons in our state capitols. Nevertheless, if sound engineering principles are to govern a decision as to the responsibility for highway wear, and payment therefor, there is no logical reason for excluding the horse-drawn vehicle from regulation and tax. In the recently passed New York State schedule of motor-truck fees, this issue was very studiously avoided. The motor-truck interests maintain—and maintain justly, in the opinion of this journal—that any measure which fails to recognize the principle of equal obligation on the part of motor-driven and horse-driven vehicles is discriminatory. Will the Michigan legislators enact the present bill into law? The measure contains a number of good features and represents progress in framing documents of this sort. Highway engineers and motor-truck owners and manufacturers will follow its course through the legislative channels with a good deal of interest.

Protecting Soft Roads

ANOTHER feature of the Michigan motor truck bill which should be noted by highway engineers is the section designed to protect country highways during the period when they are most vulnerable to the attack of traffic—during the months of March, April and May, when the frost is thawing out or when rains make the road surfaces exceedingly soft. The Michigan measure stipulates that during such periods the maximum carrying capacity of all vehicles—and this includes horse-drawn as well as motor-driven—shall be reduced to one-half of the amount ordinarily allowed. Presumably the decision as to when a road is too soft to carry fully loaded vehicles rests with local highway officials, who are empowered to post notices along the road for the information of vehicle owners. An infraction of this rule subjects the guilty party to fine or imprisonment. Every highway engineer knows that a heavily loaded truck traversing a soft road in early spring can do more damage in a single trip than would be possible if a whole fleet of trucks used the road regularly, day in and day out, when it was hard. In this section, the Michigan bill touches upon a matter of vital importance, especially where rural roads are concerned. On the whole, the bill gives evidence of intelligent study, and engineers elsewhere will do well to digest its contents thoroughly.

Employ the Right Engineer

EVIDENCES of the fact that Texas municipalities are seeking the solution to their sewage-disposal problems are appearing in all parts of the state. Not only has the state enacted an anti-stream-pollution law and intrusted the State Board of Health with its enforcement, but several Texas cities have already begun the construction of modern sewage-treatment works and many others are contemplating similar action. Commenting upon this condition of affairs before a recent meeting of the League of Texas Municipalities, Charles Saville, state director of public health, gave some sound advice to municipal officials responsible for the construction or maintenance of sanitary works. The following extract from his address should be part of the creed of every city official vested with the power of appointment: "Employ a hydraulic engineer experienced in the design of sewers and sewage-treatment works. In choosing this engineer, do not make the mistake of giving undue consideration to a local man or to one whose fee is low. It is not to be expected that a surveyor or a railroad man can produce the best results on a sewage-disposal project. Furthermore, an experienced man, by his knowledge of this special branch of engineering, will make savings for your city, both in the construction and operation of the works, amounting to many times his fee." This advice is not new, but it must be repeated again and again if cities, embarking on sanitary engineering projects, are to get value received for the money they expend.

Clouds of Dust

IT IS A PITY that our governmental system permits a few persons who have axes to grind, or who are misled by those who have, to stand in the way of public improvements. Manhattan Island, in New York City, is sadly in need of modern rail freight terminals, the tracks to which shall not conflict with vehicular traffic by occupying city streets. The only railroad which has rail freight terminals on this island does not possess enough track space, traverses and obstructs city streets and a large waterfront, and defaces city park property by passing along or through it in the open. The city and the railroad have long been attempting to get together on a plan for remedying the whole situation. But the average man does not investigate. He takes other people's word for things and is easily misled by falsehood. Armed with this knowledge, various groups in New York City, backed by certain newspapers usually to be found on the obstructionist side, have waged a campaign against this improvement which is fast obscuring the entire matter in a cloud of dust.

When engineers have realized the possibilities that lie in educating the public to see the economic soundness of engineering solutions worked out for problems such as this, disheartening exhibitions of the kind now being staged in New York will be more rare. Then no newspaper will dare print distorted news about an engineering undertaking, nor even the half truths emanating from zealous but misguided persons who can see only one feature of the plan. The New York Central Railroad has made a start in the direction of telling the public about the proposed plan. It has kept on display for months in its Grand Central Terminal a model of a large part of the proposed improvement. This model, however, should not merely have been displayed. It should have been placed in the center of the concourse—thrust upon the public. Then, perhaps, the pettifoggers would not have felt quite so certain of misleading the public.

The engineers of every city are deeply concerned with such improvements. Those of New York owe it to the public to speak out even more frequently and plainly than they have in this case. They alone can convince the public that engineers are not the hired draftsmen and surveyors of wicked capitalists, but the students of public needs and the creators of public works to serve those needs. With real-estate associations, societies to prevent Father Knickerbocker from spending any of his money, and amalgamations of sentimental bush-preservers bringing court actions and filling the air with outcries, have not the engineers of New York City a right to take a hand in this case, investigate it from the public point of view and present it to the city in its true light? Engineers connected with the city and with the railroad company have already done this, and their findings have naturally been assailed on the ground of partiality. Such an attack could not be made on the findings of a number of men appointed, for instance, by the Engineers' Club.

Filters Run Longer When Aëration Reduces Free Carbonic Acid

Tests at Panama Canal Water-Purification Plants Show Operating Costs Can Be Lowered by Changing Point of Alum Application

By GEORGE C. BUNKER
Physiologist in Charge of Canal Zone Water Purification

PERIODS of filter service have been more than doubled and wash-water requirements practically halved by reducing the amount of free carbonic acid in the water applied to the rapid sand plants of the Panama Canal Zone. This result has been achieved merely by changing the point of application of the coagulant solution of alum, making the alum treatment precede, instead of follow, aëration by means of spray nozzles. The first tests to free the settled water from carbonic acid were made with lime alone at the Agua Clara plant, and the aëration experiments were later undertaken at the Mount Hope plant to cut down on the amount of lime used. In a comparison of runs of a week's duration under the old and the new methods of operation the following economies were effected: Average length of filter runs increased from 19.5 to 45.9 hours; 513,000 gal. of wash water saved; number of filter washings reduced from 27 to 13; running time of two air compressors lowered from 35.8 to 18.3 hours.

FACTORS AFFECTING FILTER SERVICE

The variation in the length of filter runs is, to the writer, one of the most interesting features of the operation of rapid sand filters. For some time a study of the factors which might exert an influence has been carried on, and while uncompleted, certain facts in regard to free carbonic acid are of sufficient importance to be published at this time. It is realized that the amount of free carbonic acid in the water applied to the filters is not the only factor which determines the length of the runs. The numbers of micro-organisms and the amounts of amorphous matter and aluminium hydrate are all intimately associated with the rate of increase of loss of head.

AGUA CLARA PURIFICATION PLANT

The Agua Clara plant, in operation since Dec. 29, 1911, supplies filtered water to the Gatun district. It comprises the following units: Mixing chamber, sedimentation basin, rapid sand filters and clear-water basin.

Mixing Chamber—The reinforced-concrete mixing chamber measures 5 x 30.5 ft. in plan. Eight vertical baffles, forming alternate submerged and overfall weirs, insure a thorough mixing of the raw water with the alum solution.

Sedimentation Basin—This basin measures 70.5 x 71 ft. in plan by 10.5 ft. in depth. Its capacity is 350,000 gal. A pressure wall separates it into two divisions of equal size, thus forming two basins which are operated in parallel. Each division is further subdivided by a baffle-wall into two compartments, each of which measures 35 x 35 ft. in plan. At the filter-building end of the basins the settled water enters a receiving box from which it passes upon the filters.

Rapid Sand Filters—There are four rapid sand gravity filters, constructed of reinforced concrete, measuring 17 ft. square by 9 ft. deep to the floor on which the underdrainage system is placed. They are arranged in two rows of two units each, with the operating floor and pipe gallery between. Each unit has a sand area of 279 sq. ft., or 0.0066 acre. If operated at a rate of 98,000,000 gal. per acre per day, each unit will deliver 646,000 gal. per 24 hours.

Embedded in the floor is an underdrainage system of the Harrisburg (Pa.) type, composed of parallel 2-in. galvanized pipes, 4 ft. long, spaced 6 in. apart, center to center, and perforated on the under sides with holes 7/32 in. in diameter, which are spaced on 3-in. centers. A 4-in. air line is tapped into each of the two manifolds. In each filter there are 24 in. of graded Chagres river gravel and 30 in. of Chame beach sand, with an average effective size and uniformity coefficient of 0.44 and 1.81 respectively.

In washing the filters air is applied for about 5 minutes and then water at the rate of 3800 gal. per minute, or 13 gal. per square foot of sand surface, equivalent to a 21-in. vertical rise per minute. The wash water is removed by two parallel concrete troughs.

Clear Water Basin—The clear-water basin is located a short distance from the filter building and has a capacity of 157,000 gal.

TREATMENT OF WATER

In the early part of 1916 the application of soda ash to the raw water, derived from an impounded reservoir, was started in order to increase the residual alkalinity of the filtered water. The proportion of alum-reactive alkalinity in the raw water has steadily diminished since the start of the plant in 1911. During the latter part of 1915 the use of a settled water of zero alkalinity and, at times, an alum acidity caused a shortening of the filter runs to about 4 hours, a cementing together of the sand, with the formation of hard spots in the filters, a marked corrosive action on service pipes and a harmful physiological effect.

After an experimental period, during which soda ash and lime were applied to the raw and settled water at different points, the best results were obtained by applying a saturated solution of lime water to the settled water as it passed into the second half of the sedimentation basins. It was immediately noticed that, with an increase of alkalinity and an accompanying decrease in free carbonic acid, the length of the filter runs increased and the hard spots gradually disappeared.

Due to the various changes in piping, the installation of short circuiting baffles and a lime-feeding apparatus and various repairs incidental to the improved operation of the plant, the continuous reduction of free carbonic acid in the settled water to a desirable minimum has been practically impossible. In addition variations in the strength of unslaked lime, which is shipped to the Canal Zone in steel drums, render an even treatment of the water difficult.

CARBONIC ACID SHORTENS RUNS

The following table shows the rapid jumps in loss of head during a typical short run as a result of applying to the filter a settled water containing 8 parts of free carbonic acid:

Hour	Loss of head, feet
7.00 a.m.	0.7 (initial)
8.00 a.m.	2.0
9.00 a.m.	4.6
9.40 a.m.	7.6 (final)

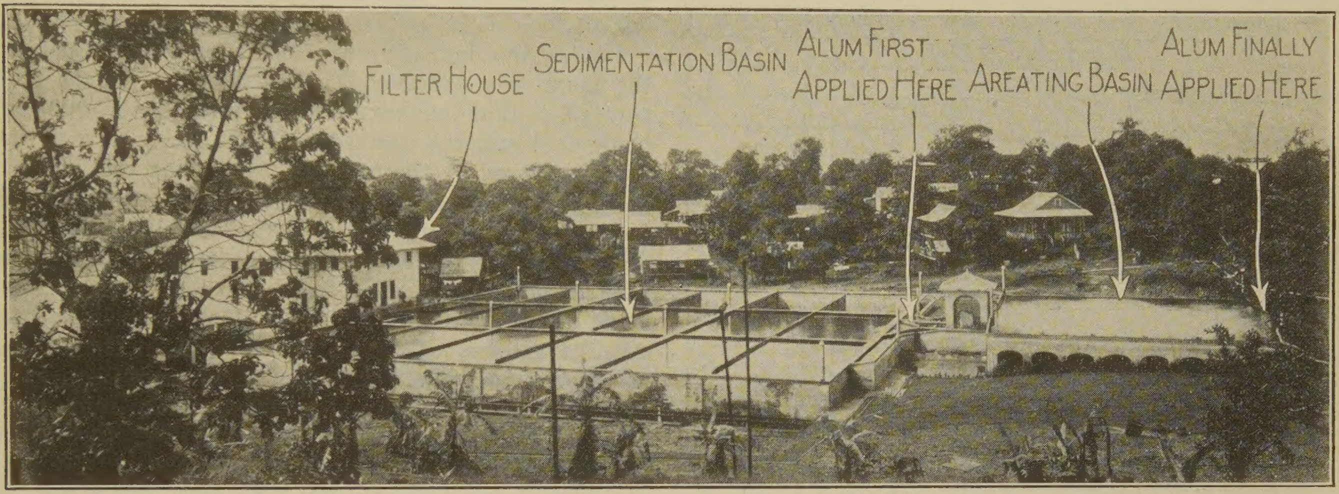
After a short run of this kind, when a filter is drained down to within a few inches of the sand, a large amount of air is liberated from the filtering material if a rake or pole is pushed down into it or even drawn through the surface layer of sand.

The influence of the amount of free carbonic acid in the settled water applied to a filter is well illustrated in the following case: A filter was placed in service at 7 a. m. with an initial loss of head of 0.8 ft., which increased to 2.3 ft. at 11 a. m. At this time the free carbonic acid in the water on top of the filter was 3.5 parts per million. The amount of lime solution applied to the settled water was increased. At 3 p. m. the loss of head had reached 6.8 ft., but at 4 p. m. it had dropped back to 4.5 ft. and the water on top of the filter was neutral to phenolphthalein. If the free carbonic acid in the settled water had been allowed to remain at 3.5 parts per million, the length of the run would have been 9 hours, but by increasing the lime, rendering the water neutral or slightly alkaline and removing the accumulation of gas in the filtering material, it was increased to 17 hours.

With the free carbonic acid in the settled water averaging 1.0 part, a run of 52 hours has been obtained. With the lime cut out, as has happened several times due to a shortage, the length of the runs immediately decreased to a minimum of 3 hours.

In order to reduce the amount of lime, the writer decided to try to remove part of the free carbonic acid, liberated by the formation of aluminium hydrate, by aëration of the raw water after the addition of the alum solution. An experimental aërator, built of wood and patterned after those in use at South Norwalk, Conn., was built over the inlet end of the mixing chamber. It measured 4 x 8 ft. in plan by 4 ft. deep. The bottom was perforated by ¼-in. holes spaced on 1-in. centers and was raised above the top of the mixing chamber so as to give a fall of 4 ft. to the water flowing through it. A temporary bypass from the raw-water main brought the water up to the top of the box, where it was discharged into a trough, from which it splashed over and down to the perforated bottom.

The solution of alum was applied to the raw water just before it entered the box, so that the liberation of the free carbonic acid, due to the formation of aluminium hydrate, was effected before the water passed out through the bottom of the box. Tests made by the writer indicated that this aërator would not remove more than 50 per cent of the free carbonic acid added to the water by the alum, which left, under present conditions of operation, about 7 parts to be removed by lime treatment. In order to determine whether or not more effective decarbonation would result by spraying the water through the air by means of nozzles, further experiments were carried on at the Mount Hope purification plant.



MOUNT HOPE RAPID FILTER PLANT AT CANAL ZONE, SHOWING POINTS AT WHICH ALUM WAS APPLIED

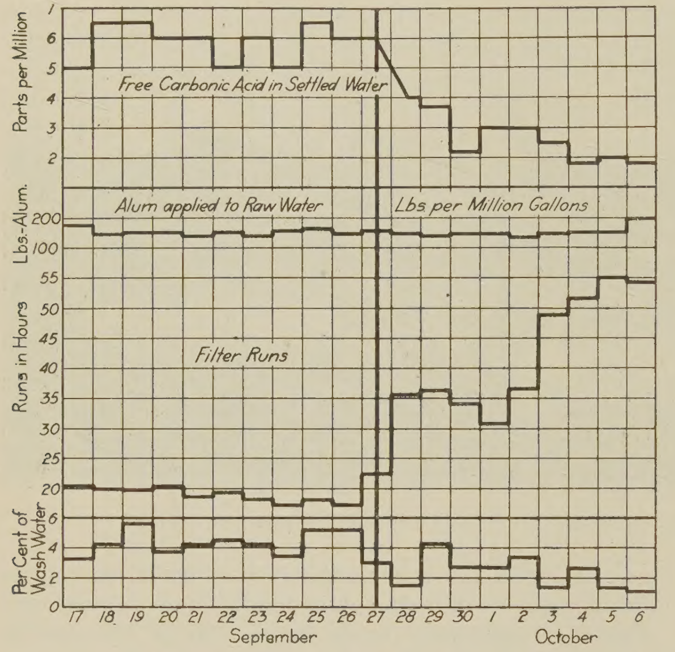
MOUNT HOPE PURIFICATION PLANT

The Mount Hope plant, in operation since Feb. 23, 1914, supplies filtered water to that portion of the northern district which lies north of and includes Mount Hope, Colon, Cristobal and Margarita Point, with a combined population of about 37,000. It comprises the following units: Aëration basin, sedimentation basin, rapid sand filters and clear-water basin.

Aëration Basin—This basin, measuring 60 x 66 ft. in plan, is equipped with 85 cone nozzles, which are arranged in five batteries of 17 each. The nozzles are so adjusted that, under ordinary operating conditions, the raw water is discharged at an angle of 30 deg. in a thin sheet which breaks up into fine drops. The average diameter of the circle which is formed by the discharge of one nozzle striking the floor is 24 ft. The average loss of head due to the nozzle itself is 1.95 ft.

Mixing Chamber—From the aëration basin the raw water flows through three parallel mixing chambers in which vertical baffles, forming alternate submerged and overfall weirs, insure a thorough mixing of the raw water with the alum solution.

Sedimentation Basin—From the mixing chambers the alum-treated water flows into three cross-connected parallel concrete sedimentation basins, with a total capacity of 2,500,000 gal. The length of each basin is 171 ft., the combined width of the three is the same, the depth at the floor valleys is 13 ft. 6 in. and that at the summits 12 ft. 3 in. Each basin is divided into three compartments, 56 ft. 8 in. square, by two pressure walls, which are provided with four rectangular openings, 1 ft. wide by 4 ft. long, placed 3.5 ft. below the water level. Extending across these baffle walls in front of the openings are concrete skimming troughs which reach to within about a foot of the normal water level. Between the pressure walls there is a light baffle wall in each compartment which extends from one side to within 6.5 ft. of the opposite side.



BY MAKING ALUM TREATMENT PRECEDE INSTEAD OF FOLLOW AËRATION FREE CARBONIC ACID WAS REMOVED AND FILTER RUNS LENGTHENED—CHANGE IN OPERATION METHODS WAS MADE SEPTEMBER 27

Rapid Sand Filters—There are six rapid sand gravity filters, constructed of reinforced concrete, measuring 27.5 x 18.66 ft. and 10.25 ft. deep to the floor on which the underdrainage system is placed. They are arranged in two rows of three units each, with the operating floor and pipe gallery between. Each unit has a sand area of 513 sq. ft., or 0.1178 acre. Operated at the present rate of 104,200,000 gal. per acre per day each unit delivers 1,226,000 gal. per 24 hours. Embedded in the floor is an underdrainage system of the Harrisburg (Pa.) type, identical in detail with that described under the Agua Clara plant. Each of the two manifolds is tapped with a 4-in. air line. In each filter there are 22 in. of graded Chagres River gravel and 30 in. of Chame beach sand, with an average effective size and uniformity coefficient of 0.41 and 1.70, respectively.

In washing the filters, air is applied for a period of 4 to 5 minutes, followed by water at the rate of 5900 to 6000 gal. per minute, or 11.1 gal. per square foot of sand surface, equivalent to a 17.5 in. vertical rise per minute. The wash water is removed by one central and eight lateral concrete troughs.

Clear-Water Basin—This is located under the filter building and has a capacity of 520,000 gal.

CHANGE IN OPERATION

After the relation between the amount of free carbonic acid in the settled water and the length of the filter runs had been observed at the Agua Clara plant the writer made the necessary changes to apply the alum to the raw water before the latter was discharged through the nozzles in the aëration basin. Table 1 contains the data from which the accompanying curves were plotted. They show the reduction in free carbonic acid in the settled water after this change was made at 1.30 p. m., Sept. 27, with the resulting increase in the length of the filter runs and decrease in amount of wash water.

During the first few days following Sept. 27 part of the alum was added to the water after it had been aërated, so that the maximum reduction of the free carbonic acid was not effected until the latter part of the period covered by the curves. Some time was also required to displace the 2,500,000 gal. of water in the sedimentation basin with an equal amount containing about 2 parts per million of free carbonic acid. The runs immediately started to lengthen as the free carbonic acid decreased. From Oct. 3 to 7 inclusive the average amount of free carbonic acid in the settled water was maintained close to 2 parts per million, with the result that the runs increased to an average of 52 hours. The shortest run for any one filter during the 10 days prior to the change in treatment was 17.3 hours; the longest run during the nine days following the change was 59.6 hours.

AËRATION REMOVES CARBONIC ACID

During the latter part of the period the amount of alum added to the raw water was varied so as to add 4.9, 7.5 and 12 parts per million of free carbonic acid by means of the formation of aluminium hydrate. Samples of the aërated water collected at suitable intervals contained 2 parts per million, the original amount present in the raw water before the addition of any alum,

TABLE 1—HOW FILTER RUNS WERE INCREASED AFTER OPERATION WAS CHANGED ON SEPT. 27 SO AS TO MAKE AËRATION FOLLOW INSTEAD OF PRECEDE ALUM TREATMENT

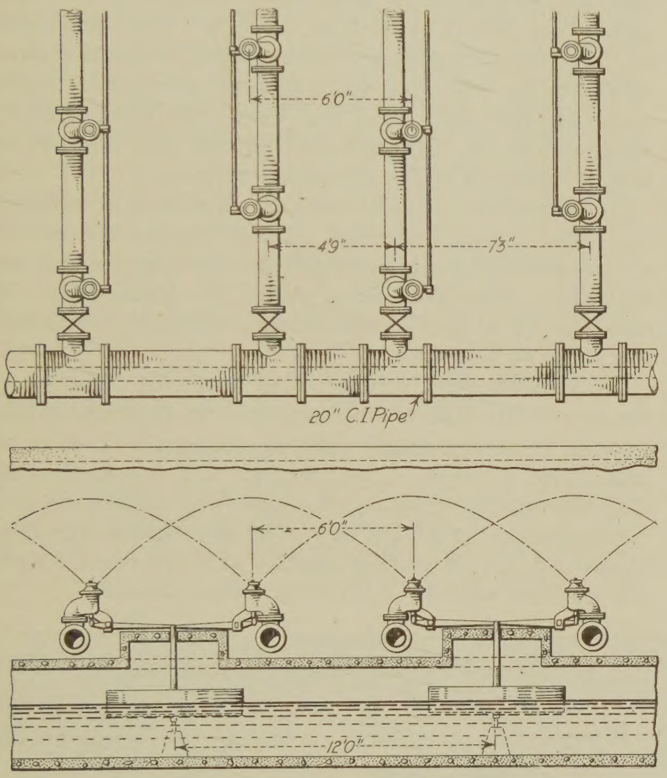
Date, 1916	Free carbonic acid in settled water, p.p.m.	Filter runs, hours	Alum, lb. per 1,000,000 gal.	Per Cent of wash water
Sept. 17	5.0	20.4	176	3.2
Sept. 18	6.5	20.0	140	4.2
Sept. 19	6.5	19.8	144	5.6
Sept. 20	6.0	20.3	143	3.7
Sept. 21	6.0	18.6	136	4.3
Sept. 22	5.0	19.3	150	4.5
Sept. 23	6.0	18.2	137	4.2
Sept. 24	5.0	17.3	156	3.4
Sept. 25	6.5	18.1	161	5.2
Sept. 26	6.0	17.4	147	5.2
Sept. 27	6.0	22.5	152	3.0
Sept. 28	4.0	35.6	144	1.5
Sept. 29	3.7	36.3	140	4.2
Sept. 30	2.2	33.8	142	2.7
Oct. 1	3.0	30.4	142	2.7
Oct. 2	3.0	36.7	134	3.4
Oct. 3	2.5	48.7	146	1.3
Oct. 4	1.8	51.5	150	2.6
Oct. 5	2.0	55.0	149	1.4
Oct. 6	1.8	54.5	196	1.3

showing that all the free carbonic acid which was liberated by the addition of the maximum amount of alum was removed by the method of aëration in use.

The physical and chemical characteristics of the raw and filtered water remained practically the same before and after the change in the point of application of the alum. The number of micro-organisms and amount of amorphous matter in the raw water did not show any notable variation.

Table 2 contains comparative data for the weeks ending Sept. 23 and Oct. 7.

It may be seen that 513,000 gal. of wash water was saved and the per cent reduced from 4.22 to 2.36; the filter runs were increased from an average of 19.5 to 45.9 hours; the free carbonic acid in the settled water was reduced from 5.9 to 2.3 parts; the number of filter washings was reduced from 27 to 13; and the running of two air compressors was reduced from 35.8 to 18.3 hours. The physical and chemical characteristics of the filtered water remained the same.



AËRATING NOZZLES AT MOUNT HOPE PLANT

During the last six months of the fiscal year ended June 30, 1916, the monthly averages of the filter runs varied from 12.3 to 19.9 hours; the number of filter washings varied from 118 to 195 per month; the monthly volumes of wash water varied from 5.7 to 10,500,000 gal.; and the monthly percentages of wash water varied from 4.45 to 8.28. Comparing these figures with those in the tables, the writer expects to make a reduction of about 4,000,000 gal. in the monthly amount of wash water consumed at the Mount Hope purification plant by removing the free carbonic acid which is liberated in the formation of aluminium hydrate. In addition to the saving effected through this decrease in the wash water, the cost of the operation of the air compressors will be reduced about 45 per cent.

TABLE 2—COMPARATIVE DATA ON OPERATION FOR WEEKS ENDING SEPT. 23 AND OCT. 7

Data	Week ending Sept. 23, 1916	Week ending Oct. 7, 1916
Water, filtered, gallons	27,729,000	27,806,000
Wash water, gallons	1,169,000	656,000
Per cent of wash water	4.22	2.36
Pounds of alum per million gallons	147	152
Filter runs in hours:		
Average	19.5	45.9
Maximum	23.0	59.6
Minimum	15.2	28.0
Free carbonic acid, parts per million:		
Settled water:		
Average	5.9	2.3
Maximum	6.5	3.0
Minimum	5.0	1.8
Raw water:		
Average	2.8	1.9
Maximum	3.5	2.5
Minimum	2.0	1.5
Number of filters washed	27	13
Air compressors, total length of runs, hours	35.8	18.3

The writer desires to acknowledge the assistance received from Theodore R. Kendall and Harry T. Campion, resident chemists at the Agua Clara and Mount Hope purification plants.

Investigation of Slag as Aggregate for Concrete

Strengths Averaging 50 Per Cent Higher Than Gravel Concrete at 28 Days Were Obtained—Requires 15 Per Cent More Cement

THE RELATIVELY high strength of slag concrete is well known, but few tests have been made to compare the relative value of different slags and to study comprehensively the various qualities. Such an investigation and tests, described in a paper presented before the annual meeting of the American Concrete Institute by Sanford E. Thompson, consulting engineer, of Boston, are taken by permission from a report made by the author to the Stone & Webster Engineering Corporation for the purpose of determining the availability of slag as an aggregate for plain and reinforced concrete. Several series of tests were undertaken, and conclusions are drawn from these tests and from a study of previous investigations.

CONCLUSIONS RESULTING FROM TESTS

As a result of the tests the following conclusions have been reached:

1. The strength of concrete made with slag, such as is obtainable commercially in eastern and northern Ohio, was on the average about 50 per cent higher at the age of 28 days than gravel concrete made with first-class materials.

2. Using the same proportions by volume as for gravel concrete, about 15 per cent more cement on the average was required per cubic yard for slag concrete than for gravel concrete of the same proportions.

3. No authentic cases of deterioration of slag concrete made with Portland cement or of rusting of steel embedded in such concrete have been discovered.

4. Porous slag produced a concrete of substantially the same strength at 28 days as dense slag. At later ages the dense slag is probably stronger.

5. Slag made by different processes and under different conditions showed no marked difference in strength and other characteristics.

6. An extremely hard, dense, acid slag did not produce a concrete of greater strength than porous, basic slag on a 28-day test.

7. The weight of the slag concrete tested averaged about 6 per cent lighter than an average gravel concrete. On the other hand, very dense acid slag concrete was heavier than gravel concrete.

8. Granulated slag sand produced a mortar of inferior tensile strength on short-time tests.

9. Crushed-slag screenings produced a mortar appreciably higher in strength than standard-sand mortar.

Tests thus far made for permeability of slag concrete are insufficient to determine its availability for thin watertight work such as tanks. The weathering qualities of slag concrete are indicated as satisfactory by examination of structures which have been built for a number of years.

SPECIFICATIONS FOR USE OF SLAG FOR CONCRETE

The tests have not been extended over a long enough period to warrant final recommendation for specifications. It appears from the results thus far obtained that for practical construction:

Slag must be air-cooled, crushed, screened from dust, and free from foreign material. The weight of screened slag when shaken to refusal should not be less than 65 lb. per cubic foot.

On account of the nature of the slag, exceptional care must be used in proportioning, mixing, and placing, especially where concrete is chuted, to insure a uniform dense mix.

Commercial practice requires the banking of slags which are low in magnesia (say 1 to 2 per cent) for at least six months. Slags of higher magnesia content (say 5 to 6 per cent) appear to require a much shorter period of seasoning.

If the Joint Committee's method of basing allowable stress on strength of cylinders at 28 days is followed, it would be permissible to use with the slag concrete 50 per cent higher stresses than with gravel concrete, or, conversely, to use lean enough proportions in similar ratio. While so large a stress is not yet warranted without still more extended tests, the results indicate that where slag is accepted for use it is permissible to use at least 15 per cent less cement with the same stresses so as to put the slag concrete on the same basis, commercially, as gravel concrete. This would permit proportions 1:2½:4¼ in place of 1:2:4 commonly used in reinforced concrete. The slightly larger ratio of sand to coarse aggregate suggested is advantageous in filling the voids.

FURTHER TESTS NEEDED

Further information is desirable on long-time tests of slag concrete exposed to air and to moisture to compare the relative value of porous and dense slag as aggregates. Certain of these specimens should be ground so as to expose the aggregate to the weather. Permeability tests, tests of modulus of elasticity, and tests of expansion from changes in temperature and moisture also should be made.

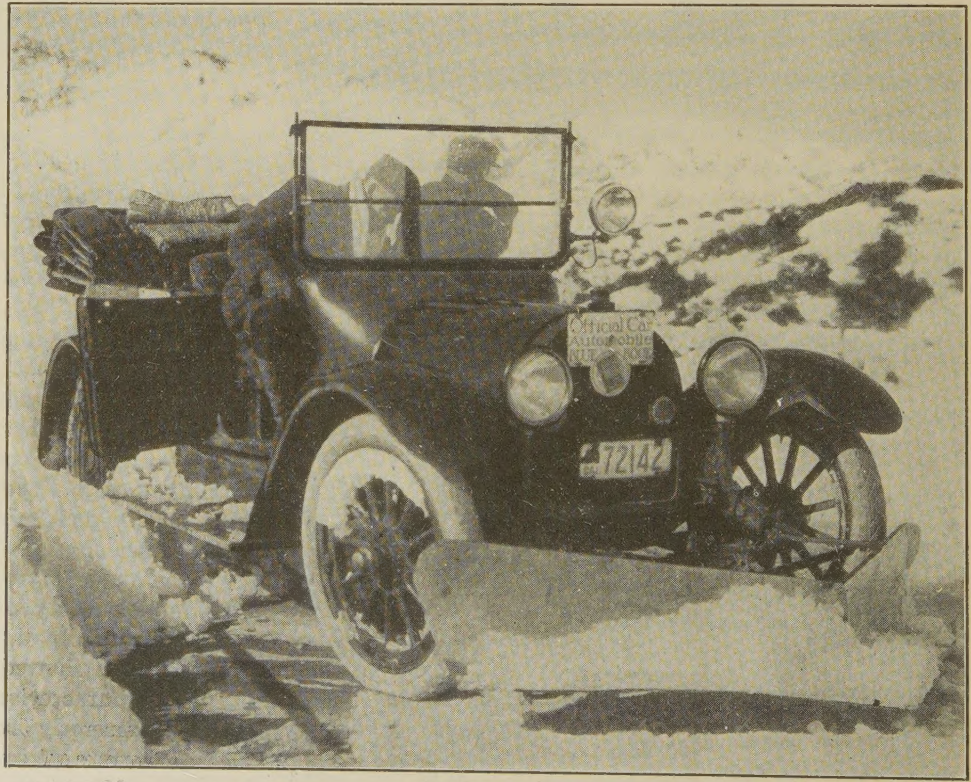
Improvised Auto Snow Plow Clears California Highway

Steel Plates on Front of Chassis Successfully Attack Two-Foot Fall on Los Angeles-Bakersfield Ridge Route

DURING recent storms the ridge route between Los Angeles and Bakersfield, Cal., opened to traffic last year by the California Highway Commission, was subjected to a fall of about 2 ft. of snow. This presented an unusual situation in which special measures were necessary to clear the road so that automobile traffic could get through. This was done with hand shovels, scrapers and any equipment so located that it could be hastily delivered to the blockaded sections.

In connection with this work an enterprising automobile sales agency undertook to demonstrate the use of an automobile hastily equipped for clearing snow from highways. The illustration shows the device used. It consisted of a pair of steel plates fastened to the forward end of the chassis.

Best results were secured, it is stated, by "charging" the snowdrifts with a running start. In this way it was possible to plow through a depth of about 2 ft. of snow and throw it clear of the roadway for a considerable distance before expending the combined momentum and maximum energy of the car. The experiment was conducted by the automobile agents, and the results were not observed officially by state highway officials.



EMERGENCY SNOW PLOW ATTACHED TO AUTOMOBILE

Edison Portland Cement Plant Remodeled

Advantage Taken of 1915 Lull in Business to Install Combination Ball-and-Tube Mills and Other Machinery of Modern Type

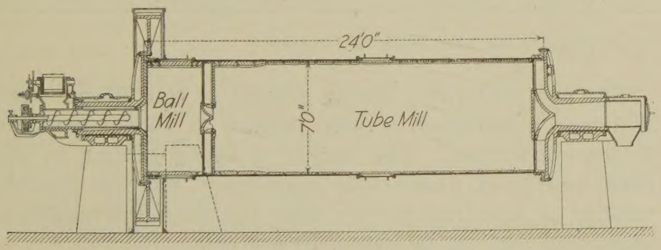
By PERCY H. WILSON
Consulting Engineer, Philadelphia

DURING the year 1915 the Edison Portland Cement Company, owing to the ruinous price at which Portland cement was being sold, shut down its plant at New Village, N. J., and withdrew its brand from the market. The nucleus of its organization was retained, and plans were begun immediately for extensive changes in the mill in order to effect a saving in the cost of manufacture, and at the same time meet those changes in the character of Portland cement demanded by increased knowledge of the material. The plans have been carried out and a comparison of the results obtained by the old and the new methods is afforded.

The original plant started operation in 1902, at a time when only 9,000,000 bbl. of Portland cement was manufactured yearly in the United States, and the principles of the machines installed were such an advance in the art of manufacture as to cause much comment and stamp Thomas A. Edison as one who had thoroughly analyzed the future requirements of the cement-using public. Because of the attention which the original installation commanded, the changes just completed are of more than ordinary interest.

ORIGINAL PLANT A MODEL

A thorough description of the plant as originally built is contained in the Engineering Record of Dec. 26, 1903. Since that time the plant has manufactured and shipped more than 15,000,000 bbl. of cement. The main principles involved, which have been and are being used by practically every cement-manufacturing company in the United States, were the long kiln, the automatic weighing device for proportioning materials, the crushing of material by the use of rolls, the air separation or sizing of the ground particles and the use of individual electric motors for operating all plant units except the rolls.



COMBINATION TUBE-AND-BALL MILLS A FEATURE OF THE REMODELED PLANT

Cement manufacturers in all parts of the United States, profiting by the experience of the Edison company, adopted such of these principles as best fitted their own particular materials, making changes and improvements in recognition of the development of the art at the time of the change, or in the building of new plants. The adoption of the long kiln and of the automatic weighing device was almost universal. Individual electric drive has been quite generally adopted. Rolls for preliminary crushing of the raw material have been installed in several plants. The principle of air separation is used in many types of grinding machines accepted as standard, and is in use in many cement plants.

NEW LIMITS IN PORTLAND CEMENT

Engineers and contractors, having become accustomed to the use of natural cement, were not so insistent fifteen years ago on the uniformity of action of Portland cement as they are to-day, and the control of the various stages of manufacture necessary to obtain such uniformity of action was not so generally understood. As greater knowledge was obtained, however, specifications were changed, closer limits were placed on the manufactured product and account was taken not only of the physical properties of the cement but also of its uniformity of action in use. During the last few years it has become quite generally known that not only the amount of cement passing the 200-mesh screen has an effect on its cementing quality, but that cement which would pass a 300, 400 or 500-mesh screen, were such a screen commercially possible, plays even a more important part.

The fineness of the raw material when it enters the kiln also has an effect on the uniformity of the clinker and makes the control of the later processes of manufacture much more simple, insuring a greater uniformity of action of the finished product. It will readily be seen that the method of grinding employed has much to do with the real fineness of both the raw material and the finished product.

EDISON CHANGES RECOGNIZE ADVANCES

The changes which the Edison company has made have fully recognized all these advances in our knowledge of Portland cement. In planning the changes the company has profited by the action of the various classes of grinding machinery in use in other cement mills, not only in the Lehigh valley but in all parts of the United States.

Briefly, for crushing both raw material and clinker down to ½ in. the company has retained its roll crushers. For the final grinding of both raw material and clinker it has installed combination ball-and-tube mills, accepting for the final reduction of its materials the principles of grinding accepted as standard wherever cement is manufactured. The present method of manufacture is in principle the same as that employed by the other Lehigh valley mills.

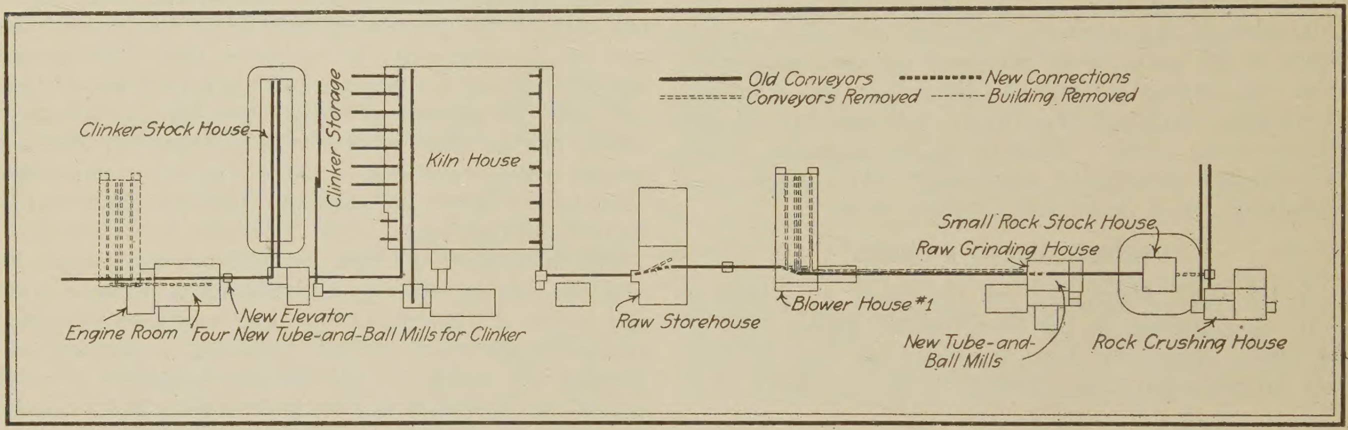
The objects to be obtained in the remodeling of the plant were the manufacture of a more uniform product, the installation of such machinery as would insure such uniformity with minimum variations and a decreased amount of labor, and with such an installation as would result in a reduction in the cost of manufacture.

It is much more difficult to plan changes in an old plant than to plan a new plant. Dr. H. E. Kiefer, works manager, made fifteen plans, each of which would accomplish the first two of the desired results. In this work consideration was given to the present power capacity, utilizing to as great an extent as possible the old arrangement of the plant, as well as the old machinery thrown out of commission by the new method of final grinding.

The plan ultimately adopted made necessary a redistribution of power, the moving of the tube mills, which are being used to increase the fineness of coal grinding, and the scrapping of the entire air-separation system, as well as seven sets of rolls previously used for final grinding of both raw material and clinker. A slight rearrangement of conveyor belts was made.

COMBINED TUBE-AND-BALL MILLS

The new installation consists of eight 7x24-ft. combined tube-and-ball mills, made by the Allis-Chalmers Manufacturing Company. These are the largest tube mills in use in the United States. Four of them are for the grinding of the raw material and four for the grinding of the clinker. The installation is the same on both the raw material and clinker grinding sides. Two of the mills on each side are driven by a vertical cross-compound engine, also made by the Allis-Chalmers company. These two engines were used to run the abandoned roll grinders. The other four mills, two on each side, are driven by individual 450-hp. direct-current motors, manufactured by the General Electric Company.



GENERAL PLAN OF THAT PART OF EDISON PLANT AFFECTED BY THE RECENT CHANGES

Each of the tube mills is divided into two compartments. The material entering the first compartment has been previously reduced to ½ in. and under. The grinding in this compartment is accomplished by from 15,000 to 20,000 lb. of steel balls, ranging in size from 2½ to 5 in. in diameter. The length of this compartment can be varied from 3½ to 6½ ft. The material is here ground to such fineness that 90 per cent will pass through a 20-mesh screen. Passing through a slotted plate, the material goes to the second compartment. Here grinding is effected by 70,000 lb. of "manganoid" balls, ⅞ in. in diameter.

The fineness of grinding depends on the length of time the material remains in each compartment, this in turn depending on the speed with which the material is fed into the grinding mill. The raw material is ground until 85 per cent will pass a 200-mesh screen, and each tube mill turns out about 25 tons per hour. The clinker is ground until 82 per cent will pass a 200-mesh screen, and each tube mill turns out about 75 bbl. per hour.

The following table will give a digest of some of the results obtained, from a mechanical standpoint:

RESULTS OBTAINED BY THE CHANGES

	Old system	New system
Power—		
Raw material mills	1,712 hp.	1,862 hp.
Clinker mills	1,648 hp.	1,688 hp.
Total	3,360 hp.	3,550 hp.
Conveying and Elevating Machinery—		
Raw material mills	2,195 lin. ft.	594 lin. ft.
Clinker mills	1,942 lin. ft.	318 lin. ft.
Total	4,137 lin. ft.	912 lin. ft.
Number of Motors—		
Raw material mills	24	9
Clinker mills	36	9
Total	60	18

The two tube mills, 7 ft. in diameter by 10 ft. long, released by the change have been installed in the coal-grinding house, and have increased the fineness of coal grinding to 80 per cent through a 200-mesh screen.

The air-separation system has been eliminated.

The raw material is being ground so that 85 per cent will pass a 200-mesh screen, instead of 75 per cent, as in the old system. The clinker is being ground to the same degree of fineness as heretofore, but the present method of grinding will increase the very fine material, mentioned before, by about 10 per cent.

The time of set, based on the average of tests of 100,000 bbl., shows: Initial set, old process, 5 hours 45 minutes; new process, 3 hours 13 minutes; final set, old process, 9 hours 20 minutes; new process, 7 hours 6 minutes.

A comparison of strength tests made on material manufactured by the old and the new processes gives:

	Increase in percentage		Increase in percentage
24 hours, neat	2	7 days, 3 sand mortar	18
7 days, neat	18	28 days, 1 sand mortar	28
28 days, neat	11		

The cement passes the soundness test without seasoning.

The limits of the variation of the finished product have been greatly reduced.

The color of the new material is steel gray, when gaged neat with water. The color of the material manufactured by the old process was muddy yellow.

Measures Strains in Concrete Building for Period of One Year

Arthur R. Lord Reports Conclusions of Long-Time Test of Flat-Slab Floor—Gets Lower Stresses Than Expected from Past Experience

AS THE RESULT of tests extending over one year, new conclusions relative to stresses in reinforced-concrete buildings have been reached by A. R. Lord, consulting engineer, of Chicago. In a paper presented at the annual meeting of the American Concrete Institute he reports that stresses in the steel during the last four months of the test show practically no change, concrete deformations show progressive increase, the average increase being much more marked in the first five months than in the last seven, and that a shifting of the resisting moment occurs during the first six months, the stresses adjoining the columns decreasing and those at the center increasing, with an increase in the total moment, which averaged 10 per cent for the first eight months, with no increase thereafter. A short abstract of Mr. Lord's paper is presented here, including a diagram showing variation in time of the center deflection and of typical observed unit deformations.

TESTS MADE IN SCHWINN BUILDING

None of the extensometer tests of reinforced-concrete buildings previously made and reported have involved measurements of steel and concrete under a heavy test load held in place through a long period of time. An excellent opportunity was presented by the test of the Schwinn Building, designed by Lieberman & Klein, consulting engineers, of Chicago, shortly before the present Chicago flat-slab ruling went into effect, when each designer was required to show tests to satisfy the building department as to the sufficiency of his design. At Mr. Lord's suggestion, the test load of twice the designed dead and live load was required to remain in place one full year. The ordinary extensometer test was first made in the usual manner, and forty-four gage lines of representative character, and showing the greatest stresses of their kind and location, were selected for the measurements, extending over a period slightly exceeding one year.

The Schwinn Building is six stories in height, approximately 673 ft. long by 80 to 138 ft. wide. The panel tested, selected by J. Norman Jensen of the Chicago Building Department, was an exterior panel about 25 ft. square located on the sixth floor, where the columns were the smallest and the effective span the greatest. The elevators, toilets and washrooms for the building were located in service wings. One of these projected from the panel immediately adjoining the test panel. One concrete duct adjoined the test panel, and openings for two metal ducts were present at each of the wall columns of the test panel.

DETAILS OF TEST PANEL

The slab reinforcement was of the four-way type. One-third of the slab rods in each direct band were carried through at the column and lapped, without being bent up. All the diagonal bars were bent up. The slab was designed to be 9½ in. thick, but actually measured a uniform 10 in. practically throughout the area of the building. The interior drops were 9 ft. square at their lower surface and 6 in. thick. The wall drops were only 4 in. thick. The exterior walls were of concrete, extending 3 ft. above the floor level and 9 in. thick. The wall columns were 6 ft. 6 in. wide by 1 ft. 6 in. thick, with a pilaster 2 ft. 6 in. wide by 1 ft. thick at the center. They were reinforced by sixteen ¾-in. round rods tied at intervals with ¼-in. wire. The interior columns were reinforced by spiral and longitudinal steel.

The concrete in the test panel, columns and wall was of 1:2:4 mixture. The columns were poured on June 12, 1914, and the test panel on the following day. The wall was poured to the sill level about three hours after the slab was placed; the wall columns were poured to the same height at the same time. The cement floor finish (from 1 to 2 in. thick) was laid on the following day, the total floor thickness being 10 in. The top steel was placed after the rough floor slab concrete had stiffened considerably, and was from 1½ to 1¾ in. below the top of the slab.

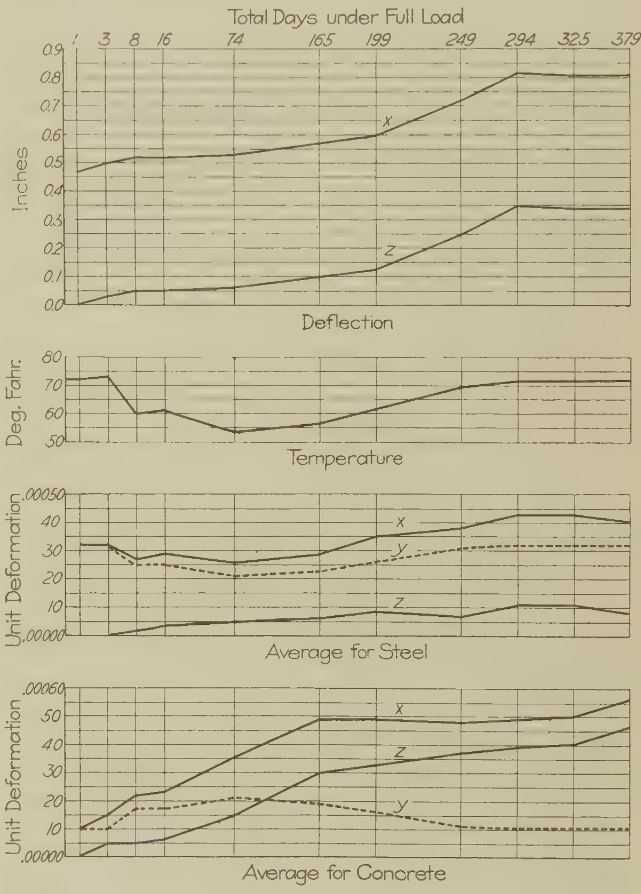


DIAGRAM FOR DEFLECTIONS AND AVERAGE UNIT DEFORMATIONS

TEST LOADING OF SAND

The first load was placed on the test floor on Aug. 14, 1914, using an average depth of 22 in. of bank sand, or about 160 lb. per square foot. On Aug. 15 the load was increased to an average depth of 38 in., very well compacted, giving about 300 lb. per square foot. On Aug. 17 the load was finally increased to an average depth of about 57 in. This final test load may be considered to have been 450 lb. per square foot. It remained in place until Sept. 2, 1915. The floor was designed for a uniformly distributed live load of 150 lb. per square foot.

The deflection at the center panel is plotted on the diagram herewith. No part of the sixth floor for several panels around the test load was used during the year, except for light trucking, and it is believed that the effect of loading adjacent panels is not involved in this test. A study of the diagram comparing the temperatures and deflection curves for the year indicates a general tendency for the deflection to increase at all times, and to decrease as the temperature falls and increase as the temperature rises. In the final three months of practically constant temperature the deflection remained nearly constant.

In a slab which is part of a reinforced-concrete building, temperature changes will not take place freely, and in interpreting measured deformations the significant figure is not the actual change in unit deformation but the difference between the actual change and the amount which would have occurred had the slab been free to contract or expand. This difference gives the actual change in stress. In the diagram the unit deformations which would have occurred had the slab been free to contract or expand have been plotted as curves Y, while the actual deformation curves are marked X. The difference between the X curves and the Y curves measures the change in actual stress, neglecting changes in the modulus of elasticity. These values are plotted as the Z curves of the diagram.

GENERAL CONCLUSIONS

The general conclusions can be stated as follows:

1. The stresses in the steel show practically no change during the last four months of the test.
2. The concrete deformations show progressive increase during the year. The average increase was much more marked in the first five months than in the last seven. This increase in the average compressive deformation is in accord with experiments on cylinders under laboratory conditions.
3. There occurred a shifting of a portion of the moment during the first six months of the test, stresses adjoining the columns decreasing, while those at the center increased. This action must be considered in establishing design coefficients.
4. The increase in the total moment, negative and positive, figured from the steel stresses was relatively small and appears to have been considerably less than 10 per cent for the year, with no increase in the last four months.
5. Comparison of the data of this test with that secured by Professors Fuller and More leads to the conclusion that the actual maximum compressive stress at the center of the panel was not in excess of 350 lb. per square inch at the full test load.
6. Both concrete and steel stresses at the end of the year appear to be materially less than those to be expected under the Chicago ruling governing the design of flat slabs.
7. This test, taken together with other time tests of concrete in compression, would indicate that the reported values of the compression in the concrete in previous extensometer tests of flat-slab buildings are somewhat in excess of the true stresses actually present. This applies especially to the final readings when the full load has been in place for 24 hours.
8. Further tests of this nature would seem to promise a material addition to our understanding of the deportment of reinforced-concrete structures under load.

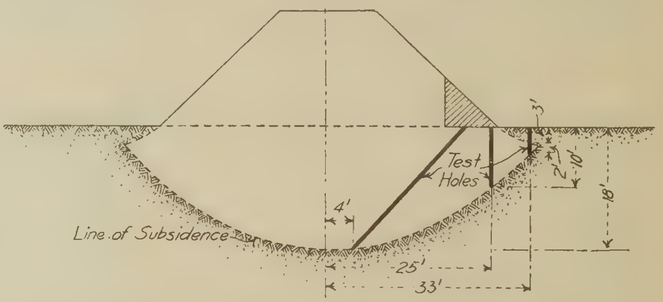
Subsidence Investigations Amply Pay Big Four Railway

250,000 Yards of Hidden Material Discovered by Test Pits and Drilling at Total Cost of $305 —Details of Drilling Outfit

By F. J. WRIGHT
Co-operative Student, University of Cincinnati

IN COMMON with other railroads the Cleveland, Cincinnati, Chicago & St. Louis Railway, in connection with the government valuation work, made subsidence tests of all fills which had given evidence of considerable settlement. The depth to which the different fills had subsided ranged all the way up to 25 ft. The filled material also varied greatly, so that it was found expedient to use two methods in determining the slope of subsidence—(1) the excavation of test pits at the toe of the slope and (2) the drilling of test holes through the fill.

The fills tested by the excavation of pits were either those which had subsided a comparatively small amount or those made of rock and other coarse material, making drilling impossible. The pits were dug at the toe of the slope, from 100 to 200 ft. apart, between the points of no subsidence at the ends of the fill. The excavation of each pit was carried back several feet into the fill, the depth varying as the downward slope of the surface of the old ground toward the center of the fill.



TYPICAL ARRANGEMENT AND DEPTHS OF DRILL HOLES

DRILL HOLES FOR DEEP FILLS

Test pits were impractical in sounding fills which had subsided more than 8 or 10 ft. The presence of water near the surface of the marsh or bog made the test-pit method more unsatisfactory. When these conditions were found, test holes were drilled down through the fill with an ordinary soil auger until old ground was reached. To facilitate drilling, pits were usually dug at the toe of the slope, in about the manner shown in the drawing.

The drilling outfit consisted of the following material:

One 2-in. soil auger welded to a 6-ft. length of 1/8 x 1¼-in. galvanized-iron pipe, the upset end threaded for a 1¼-in. standard pipe; ten 5-ft. lengths of 1/8 x 1¼-in. galvanized pipe, threaded at both ends; three 5-ft. lengths of 3/16 x 2½-in. galvanized pipe (casing); eighteen 1¼-in. galvanized pipe sleeve couplings; two 16-in. Stillson pipe wrenches, and one length of 2-in. galvanized pipe fitted with a standard 1¼-in. galvanized pipe tee at the center (handle).

When the test holes were less than 6 ft. deep, the pipe handle was attached to the end of the auger. In the case of deeper holes the pipe handle was removed and pipe lengths were added as the depth of the hole demanded, the auger being turned with the pipe wrenches. The pipe casing was used only in fills containing cinders, sand, or coarse gravel, and was driven down until it passed through the material causing the difficulty in drilling.

In putting down a test hole, the driller withdrew the auger at about every foot of depth, and the earth brought up was examined and removed. The drilling was continued until material was reached which could be identified with the surrounding land. In cases where the filled earth and old ground were similar as to color and formation, roots and twigs in the latter aided in distinguishing between them.

The estimated yardage due to subsidence of eight fills sounded was 250,000 cu. yd. This work, which involved 1090 lin. ft. of drilling and 270 cu. yd. of shovel work, was accomplished at a total cost of $305.

Michigan Proposes to Regulate Trucks

Graded Weights and Speeds Allowed, Depending on Tire Widths and Wheel Diameter—Soft Roads Protected

By D. A. THOMAS
Michigan State Highway Department

THERE is now before the Michigan Legislature a tentative law regulating the operation and use of wagons, motor trucks and trailers. It aims, as far as possible, to prevent overloading and consequent damage to the highways in the future. The intent of the proposed law is the reasonable regulation of all trucking traffic, whether horse-drawn or motor-driven, without imposing any great restrictions upon the trucks and trailers already in service. It is designed to be fair and at the same time to safeguard the interests of the public.

Although in Michigan the trucking of heavy loads over country roads is not yet universal, this practice is common in the central and southern parts of the state and in the iron and copper mining districts of the upper peninsula. Shippers, mostly large manufacturers, have found that by using heavy trucks for short hauls overland they could save time and money. While the condition is not, however, as serious as that in many of the eastern states, many roads have been seriously damaged. Michigan proposes to profit by the experience of others and to use the proverbial ounce of prevention.

Wagons Classed as Trucks

The provisions of the proposed legislation will make it unlawful to operate upon the public highways any vehicle the gross weight of which exceeds 15 tons—farm implements and machinery used in road construction excepted. Nor will it be lawful to operate any vehicle—unless motor driven—which has a gross weight per inch width of tire exceeding 600 lb. This latter provision is aimed at wagons. For motor trucks, the greatest loading per inch width of tire is about 730 lb., as indicated in the table. No motor truck or trailer shall have a gage of more than 75 in., measured from center to center of tire, and shall not be more than 96 in. wide over all, nor more than 12 ft. 6 in. in height.

Driving wheels having tires of metal that may come in contact with the surface of the road, or which have a partial contact of the metal with the surface of the road, are not permitted. Chains and other non-skid devices are excepted, but the owner of the truck shall be liable for any damage to the road that may result from their use. It is not the intent of the law to prevent the use of steel tires on trailers.

Provisions Are Specific

The following limits of sizes, weights and speeds of motor trucks and trailers are established:

Schedule for the Regulation of Motor Trucks and Trailers Upon the Highways

for a wheel 32 inches in diameter

Size of Tire, In.	Single Tire Max'm Wheel Load, Lb.	Single Tire Miles Per Hour	Double Tire Max'm Wheel Load, Lb.	Double Tire Miles Per Hour
2	700	20	1400	18
2½	900	20	1800	18
3	1200	20	2400	18
3½	1600	20	3200	16
4	1900	18	3800	14
5	2200	16	4400	13
6	2700	14	5400	12
7	3200	12	6400	10

For a 34-in. wheel multiply the above figures by 1.1
For a 36-in. wheel multiply the above figures by 1.2
For a 38-in. wheel multiply the above figures by 1.3
For a 40-in. wheel multiply the above figures by 1.4
For a 42-in. wheel multiply the above figures by 1.5
For a 44-in. wheel multiply the above figures by 1.6

All motor trucks or trailers are required to have, conspicuously displayed, information regarding their height of wheel, width of tire, gage, width over all, weight and carrying capacity.

Spring-Time Conditions Considered

Three-quarters of the gross weight of a truck or trailer and its respective carrying capacity shall be on the rear axle, while the front axle is to carry the remaining one-quarter. In both cases the wheel loads must come within the limits prescribed in the table.

An unusual feature of the law provides that during March, April and May, if by reason of the thawing of frost, or rains, the roads are in soft condition, the maximum carrying capacity of tires on all vehicles shall be limited to one-half the carrying capacity of tires as provided in the act. If at any other time any county, district or township commissioner deems it necessary by reason of the soft condition of the roads to put this provision of the act in force, he can do so by the mere posting of notices along the highway.

Special permission for the moving of heavy vehicles which exceed the limits of the law is provided for.

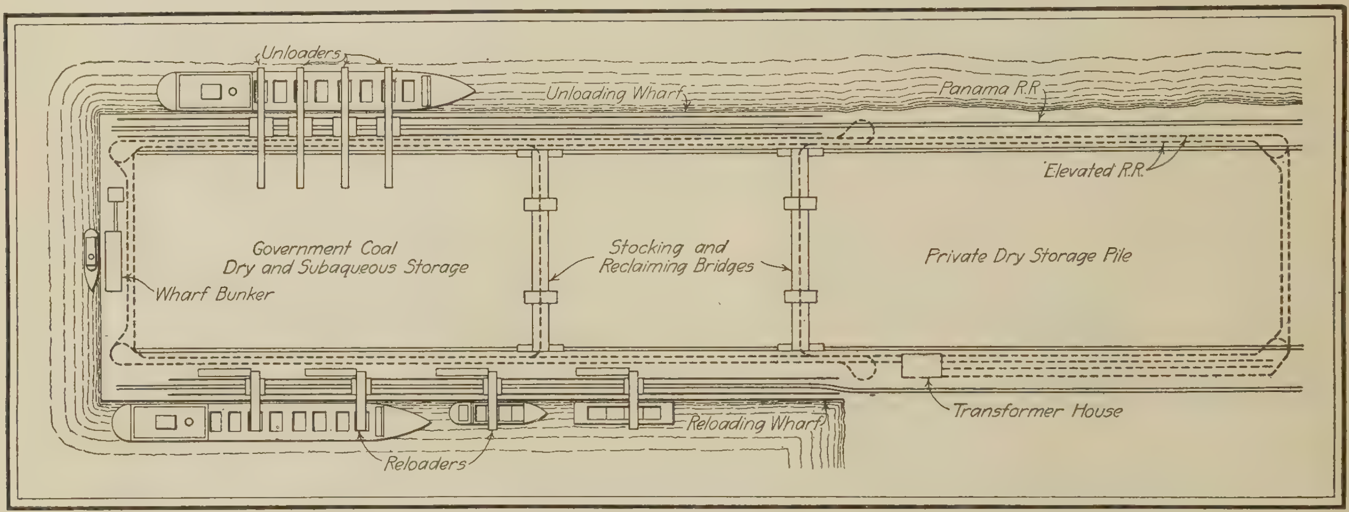
State-Aid Highway Bridges of Standard Design

The road laws of Wisconsin place the bridge work on the state-aid highways under the State Highway Department and authorize the latter to prepare plans and specifications. Previous to the preparation of these standard plans it was customary to have separate plans made by the competing contractors, who naturally were more interested in securing approval than in proper design. Selection was more likely to be based on the merit of the advocate than on the merit of the plan.

Reloaders Used in Place of Expensive Wharf Bunkers

Construction and Operation Features of Panama Canal Coaling Plants Summarized—Emergency Capacity 700,000 Tons

A TOTAL maximum capacity of 1200 tons per hour for the unloaders and 2400 tons per hour for the bridge diggers and reloaders is a feature of the Cristobal coaling plant which has been in commercial operation for several months and is located at the Atlantic terminus of the Panama Canal. The other canal coaling plant, at Balboa, has just been completed. According to an article in the *Panama Canal Record,* on which this description is based, the two coaling plants have a total combined emergency capacity of 700,000 tons, with a combined normal capacity of 500,000 tons, of which 350,000 is at the Cristobal plant, due to the fact that most of the coaling is expected at the Atlantic terminus.



ARRANGEMENT OF CRISTOBAL COALING PLANT, AT ATLANTIC END OF PANAMA CANAL

Another feature in the design is the use of reloaders, in place of the heavy and expensive wharf bunkers which have been provided in most coaling plants elsewhere. However, a wharf bunker has also been built at each of the plants, to be used whenever a small supply of coal is required, such as for tugs or other comparatively small craft, thus rendering it unnecessary to start up the heavy machinery.

GENERAL DESIGN OF CRISTOBAL PLANT

The unloader and reloader wharfs at the Cristobal plant are on opposite sides of a pier along which the bottom is dredged to a depth of 41 ft. at mean sea level for a distance of 1065 ft. With the addition of an end wharf, a total berthing space of nearly 2500 lin. ft. is provided. Beyond the end of the dredged area a length of approximately 600 ft. is considered as shore extension and has no water front.

The coal pile between the two wharfs is spanned by two movable heavy steel structures known as stocking and reclaiming bridges, which are capable of traveling the entire length of the pile and thus, by the addition of other moving units known as bridge diggers, which can move along the bridge, any part of the storage pile may be reached, including the subaqueous as well as the dry areas. Also supported by the unloading wharf, and commanding its entire length, are four moving units known as unloaders, while four reloaders are found on the opposite side of the pier. On the end wharf is located a wharf bunker of 1500 tons capacity, the use of which is described in the foregoing. The unloaders are operated by steam, although electricity is used for the remainder of the plant, which is electric-lighted throughout.

Surrounding the entire coal pile is a double-track elevated railroad of 3-ft. gage supported by a steel viaduct structure. There are also lines of standard gage running the full length of both the unloading and the reloading wharfs and connecting with the main line of the Panama Railroad.

OPERATION OF COAL-HANDLING MACHINERY

For unloading and stocking, one or more of the unloaders, which are equipped with 2½-ton buckets and have a normal rated capacity of 250 tons per hour, take the coal from a collier or a barge and deliver it to 10-ton cars, rated at 200 ft. per minute, running on the elevated railroad. The cars are stopped and started by trackmen and, upon being loaded, travel without attendance over a predetermined route to the dumping point on one of the stocking and reclaiming bridges, whence they continue to the point of reloading. When the wharf bunkers are to be filled, the coal is dumped into a hopper, from which it is fed into the bunker by means of a series of belts.

The coal is reclaimed from storage by using one or more of the four bridge diggers, each equipped with a 5-ton bucket and capable of removing the coal from any point. After delivery to the cars by hoppers and valves, it is carried to the reloaders, to the wharf bunkers or to some other part of the storage pile.

In the case of the reloaders, appendages known as "trailers," consisting essentially of a hopper at the lower end supported on wheels, receive the coal from the cars and deliver it to an inclined belt, from which it is finally transferred to its destination by means of a hinged telescopic chute capable of vertical action. As previously stated, these reloaders are used in place of the heavy and expensive wharf bunkers, the reason being that they are comparatively inexpensive, while affording a range and capacity of discharge equal to that of a very high wharf bunker.

The weight of coal handled is ascertained by four semi-automatic scales, so situated that a car must pass over a scale before reaching its point of discharge. It is proposed to use a duplicate system of weight tickets on which the scales will print the weight of each car. As before stated, the maximum capacity for the unloaders is 1200 tons per hour, and for the bridge diggers and reloaders, 2400 tons per hour, while the normal values are 1000 and 2000 tons respectively.

BALBOA PLANT

At the Balboa plant the general functions of the unloader and reloader wharves are the same, but the capacities are approximately half those at the Cristobal coaling plant. The wharves make an angle of about 135 deg. with each other, and have a total length of approximately 1600 ft., of which the unloader wharf has 850 ft. and the reloader wharf 750 ft. A depth of 34.4 ft. at extreme low water is provided.

The Balboa cars differ from those used at Cristobal in that they dump on one side only. They receive coal either from unloaders or from berm cranes, and dump directly into the storage pile or into the hoppers of either the wharf bunker or the reloaders, as desired. The berm cranes used for both the stocking and the reclaiming of the coal are of the cantilever type, operated by direct current; they consist of a central tower, resting on wheels, and supporting two cantilever arms that command the full width of the pile. The coal, upon being picked up by grab buckets attached to the berm cranes, may be distributed wherever desired by running the tower along its tracks traversing the central part of the pile and paralleling the unloader wharf. Reclaiming is done by dumping the reclaimed coal into hoppers situated in the towers of the berm cranes, from which it is loaded into conveyor cars on the trestle paralleling the berm crane tracks.

Staves for Wood Pipe Creosoted

The Wenatchee Reclamation District in Washington has ordered material for a 60 and 63-in. wood-stave pipe about 1½ miles long, the staves for which are to be given standard creosote treatment to provide a maximum protection with a minimum of free oil. About 332,000 lin. ft. b.m. of staves will be required. The pipe will convey water across the Wenatchee River and into orchards, where it will be used for irrigation purposes. Heretofore the principal objection to the use of wood pipe in an irrigation district, it is stated, has been the fact that the ends of the staves as well as the sapwood portions start to decay. Machine-banded pipe has proved less satisfactory than might otherwise be the case because the collar decayed very rapidly, as did also the ends of the pipe. The treatment with creosote is calculated to protect those points in the pipe which are most likely to decay, particularly the ends of the staves. The penetration of creosote at these points is much heavier than on the sides of the staves, and it is thus expected that the maximum protection will be afforded where it will be most needed. The creosoted staves are being supplied by the Pacific Creosoting Company of Seattle.

Safety Nets on Structural Work Introduced in California

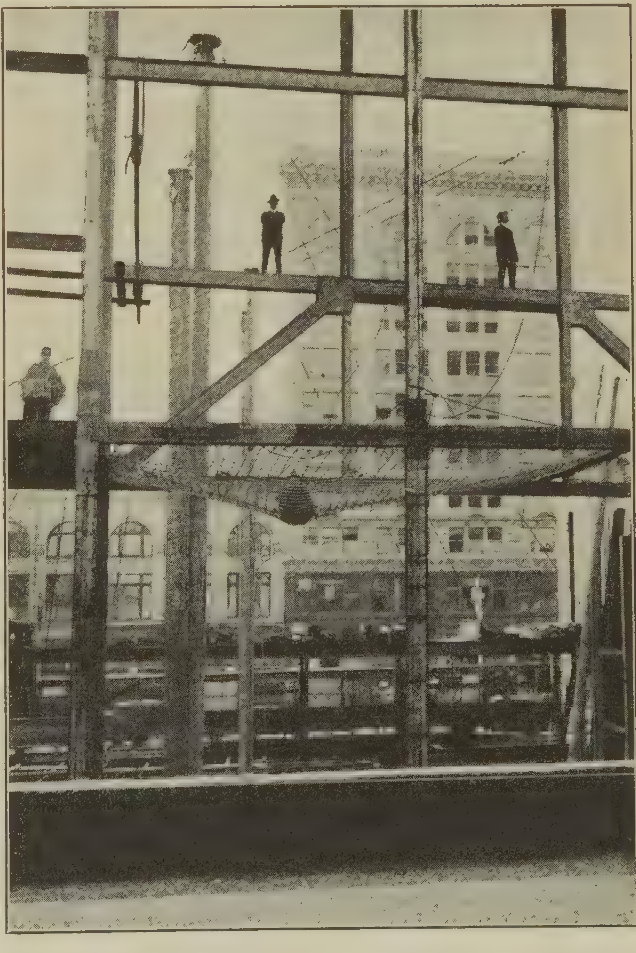
Where Plank Floors Would Be Costly, Rope Nets Will Be Required—First Trial in San Francisco

By J. J. ROSENTHAL
Safety Engineer, Industrial Accident Commission of California

IN CALIFORNIA there is a state law requiring the use of temporary plank flooring on each floor of a structure to protect workmen below from falling objects. The requirements are that there should be a plank floor for each story as the structural work progresses. But the difficulty of adhering strictly to this ruling in special cases, such as auditoriums, arch trusses in theaters, towers, bridges, etc., is such that it has in many cases been impracticable to comply with the legal requirements.

The Department of Safety of the Industrial Accident Commission of California, after devoting considerable attention to the subject, decided that the use of rope safety nets would afford a measure of protection for workmen who might fall from above; at the same time they can be used in many cases where plank floors would be impracticable. Accordingly the department has now ordered the use of such nets on all structural work where the use of plank floors is not feasible.

The safety nets are made of ½-in. manila rope with ¾-in. border and 4 x 4-in. mesh. The nets come in



NETS IN USE WHERE TEMPORARY FLOORS ARE NOT FEASIBLE

10 x 30-ft. sections, borders being provided with loops at suitable intervals so that they can be readily combined and attached to convenient points on the structural frame.

The nets are patterned after the type which has been used successfully for about a year in Chicago. In this time there have occurred at least two accidents, according to the Illinois records, which would have resulted in fatalities had it not been for the use of the nets. In these instances workmen fell into the nets without injury, instead of dropping about 100 ft. to a concrete floor.

The illustration shows the safety nets in service. These nets, the first of the kind to be used west of Chicago, were made in San Francisco at a cost of $60 apiece. They are shown in service on the California Theater being built at Fourth and Market Streets, San Francisco, by the Dean Construction Company. The theater is 100 x 170 ft. in plan and is 115 ft. high. The structure is typical of the type in which plank floors would not be practicable and illustrates the class of work on which the Department of Safety hopes to decrease serious accidents by the use of the new safety regulations.

Hetch Hetchy Work Outlined for 1917 to Cost $11,000,000

This Year to See Construction in Full Swing—Hetch Hetchy Railroad Soon to Be Operating—Contractors Invited to Visit Work

M. M. O'SHAUGHNESSY, city engineer of San Francisco, recently issued an annual report relating to the Hetch Hetchy water-supply project. In addition to a detailed account of all the work accomplished on the project in 1916, the report outlines the development program for the present year and recommends that the board of supervisors be instructed to place on sale Hetch Hetchy bonds to the amount of $11,000,000, in order to provide funds for the work to be undertaken during the present year.

The money requested is to be used for the following construction:

Hetch Hetchy aqueduct	$6,000,000
Hetch Hetchy dam	4,000,000
Lower Cherry power development	500,000
Contingent construction	115,500
Operation and maintenance of Hetch Hetchy railroad	110,000
Purchase of railroad equipment (in case operation is not contracted for)	60,000
Roads, trails and surveys	55,000
Clearing Hetch Hetchy reservoir site	30,000
Operating sawmill	30,000
Inspection and engineering in field	30,000
General office work, plans, etc.	25,000
Water rights and protective work	12,000
Compensation insurance for employees	10,000
City engineer's revolving fund	10,000
Test borings, aqueduct line	6,000
Lease of telephone, Groveland to San Francisco	4,500
Timber cut on government land	2,000
Total	$11,000,000

The railroad from Hetch Hetchy Junction, a station on the Sierra Railway, to the Hetch Hetchy dam site, a total of 68 miles, will be completed within the next few months at a cost of approximately $2,000,000. This railroad, which has a maximum grade of 4 per cent and a maximum curvature of 30 deg., and involved about 1,000,000 cu. yd. of excavation, has been constructed primarily to haul 233,000 tons of construction equipment and material to the dam and stations along the aqueduct route. Mr. O'Shaughnessy states that besides saving more than $1,000,000 in the cost of hauling material the road will become a paying investment for the city, since lumber interests in the vicinity of the dam have offered to contract for a large amount of outgoing freight on condition that the road will be made a common carrier.

The power plant to supply electricity for construction purposes is progressing rapidly. The plant will be equipped with Francis turbines operating under a head of 347 ft. The canal line, which has a capacity of 200 sec.-ft., requires five tunnels. This work is under contract and rapid progress is reported. It is expected that the construction power plant will be in operation early in the summer.

PROGRESS ON DAM AND AQUEDUCT

Satisfactory progress on the work at the Hetch Hetchy dam site is reported, notwithstanding the fact that the foundation will be carried to a greater depth than originally planned, on account of the nature of the material disclosed by prospect borings. Contract for the construction of the dam will probably be awarded during the present year. The city's sawmill at Cañon Ranch, 5 miles from Hetch Hetchy Valley, turned out during 1916 1,600,000 ft. b.m. of lumber at a cost of approximately $10 per thousand.

All the applications required under the terms of the Raker Bill have been filed with the Department of the Interior at Washington, and all but a few on which examination is still pending have been granted. The entire aqueduct line has been surveyed during the last year, and several modifications in the contemplated route have been made. Wherever possible tunnel construction has been substituted for aqueduct pipe in order to provide a line which will be the least subject to earthquake or other contingency. Across the San Joaquin Valley the location was chosen which would cause the least damage to farmlands.

HETCH HETCHY RAILROAD

Mr. O'Shaughnessy suggests that if a satisfactory agreement can be entered into with the Southern Pacific Company, the Santa Fé or the Sierra Railway, it will be advisable to consider awarding a contract to one of these companies for the operation of the Hetch Hetchy Railroad under the direction of the city engineer. However, if no satisfactory arrangement can be agreed upon, the city will organize its own operating department and the road will be run as a municipal utility. In either case the city will retain the active management of the railroad and dictate its policies.

Contractors throughout the country are invited to examine the work as soon as the weather permits (about March 20) and familiarize themselves with all details, so that when bids are invited next June they will be in a position to submit proposals.

An Army Corps for Road Work

Statistics show that about three-fourths of the average prison population is better fitted for outdoor labor than for shop work. This would amount in the United States to about 30,000 or 40,000 convicts who could be utilized for road building.

Tables Aid in Selection of Steel Purlins for Sloping Roofs

Fundamental Formula Derived for Computing Exact Maximum Fiber Stress—Applied to I-Beams, Channels, Z-Bars and Angles

By R. FLEMING
American Bridge Company, New York City

FLEXURE of beams is considered in most textbooks only for the case usually met in practice—that in which the plane of bending moment is perpendicular to a principal axis of the beam. This, however, is a special application of the general case of flexure in which the loading may be in any direction and sections are with or without an axis of symmetry. The subject of oblique loading and unsymmetrical bending has been treated in "Hütte—Des Ingenieurs Taschenbuch," but as far as the writer knows the only American textbooks in which it is mentioned are Heller's "Stresses in Structures," Green's "Structural Mechanics," and the later editions of Johnson, Bryan and Turneaure's "Modern Framed Structures" and Burr's "Resistance of Materials." Prof. L. J. Johnson in two papers, "The Determination of Unit Stresses in the General Case of Flexure," in the *Journal* of the Association of Engineering Societies for May, 1902, and "An Analysis of General Flexure in a Straight Bar of Uniform Cross-Section," in the *Transactions* of the American Society of Civil Engineers for June, 1906, leaves little to be desired in his thorough treatment of the subject.

TABLE 1.—RATIO OF MAXIMUM FIBER STRESS TO BENDING MOMENT FOR VERTICAL LOADING ON I-BEAMS AND CHANNELS

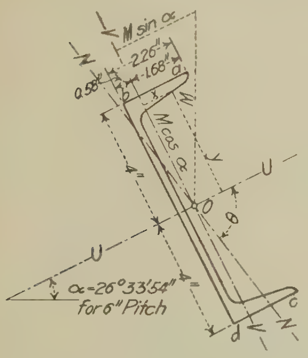
Purlin.	Pitch of roof in inches per foot. 0	1	2	3	4	5	6	7	8
6-in. 12¼-lb. I-beam...	0.138	0.212	0.284	0.352	0.415	0.473	0.526	0.573	0.614
7-in. 15-lb. I-beam.....	0.097	0.153	0.208	0.260	0.308	0.353	0.393	0.430	0.461
8-in. 18-lb. I-beam.....	0.070	0.114	0.157	0.196	0.234	0.268	0.300	0.328	0.352
9-in. 21-lb. I-beam.....	0.053	0.088	0.121	0.153	0.183	0.210	0.235	0.257	0.277
10-in. 25-lb. I-beam.....	0.041	0.069	0.096	0.122	0.146	0.168	0.188	0.206	0.222
12-in. 31½-lb. I-beam...	0.028	0.050	0.071	0.091	0.110	0.127	0.143	0.157	0.170
6-in. 8-lb. channel.....	0.231	0.396	0.557	0.709	0.851	0.982	1.101	1.207	1.301
7-in. 9¾-lb. channel...	0.166	0.296	0.422	0.542	0.655	0.758	0.852	0.935	1.010
8-in 11¼-lb. channel..	0.124	0.228	0.330	0.427	0.517	0.600	0.676	0.743	0.804
9-in. 13¼-lb. channel..	0.095	0.180	0.263	0.342	0.415	0.483	0.545	0.600	0.650
10-in. 15-lb. channel....	0.075	0.145	0.214	0.279	0.340	0.397	0.448	0.494	0.535
12-in. 20½-lb. channel..	0.047	0.094	0.141	0.184	0.225	0.263	0.298	0.329	0.357

The most common case of oblique loading is that of I-beam and channel purlins on pitched roofs. Fundamental equations will here be developed and tables given for obtaining maximum fiber stress in roof purlins in terms of bending moment for usual sizes of I-beams and channels and also for Z-bars and angles.

FUNDAMENTAL EQUATION

The figure shows an 8-in. 11¼-lb. channel on a 6-in. pitch roof. The purlin is supposed to be free to deflect in any direction. Let *M* represent the bending moment due to the vertical load and α the angle made by the rafter with the horizontal. Resolving *M* into components as shown and calling the fiber stresses due to these components f' and f'' we have for the total fiber stress f at any point with co-ordinates x and y the equation

$$f = f' + f'' = \frac{My \cos \alpha}{I_u} + \frac{Mx \sin \alpha}{I_v}$$



M cos α will produce compression at a and b and tension at c and d, while *M* sin α will produce compression at a and c and tension at b and d. The maximum fiber stress will be at a.

Taking the specific case shown in the figure and assuming the bending moment *M* to be 120,000 in.-lb., we obtain by substituting in the general equation for the point a

$$f = f' + f'' = 0.6756M = 81,072,$$

which is the unit compressive stress at a.

The unit stress at b, noting that x is 0.58 and that the two terms have opposite signs, is 10,092 tension. The unit stress at c, the two terms having opposite signs, is 54,480 compression. The unit stress at d is 36,680 tension.

If the channel were vertical the general equation would reduce to the well-known formula $f = My/I_u$ and the unit stresses at a and b would be 14,860 lb. compression, with the same in tension at c and d.

Table 1 is calculated for purlins at right angles to the rafter and gives the maximum fiber stress in decimal parts of the bending moment.

The neutral axis N-N can be located by finding the angle θ which it makes with OU. Bearing in mind that the fiber stress is zero for all points on the neutral axis, the term f in the general equation becomes zero and

$$\frac{\sin \alpha}{\cos \alpha} = -\frac{I_v y}{I_u x}$$

But $\dfrac{y}{x} = \tan \theta$ and $\dfrac{\sin \alpha}{\cos \alpha} = \tan \alpha$, therefore

$$\tan \theta = -\tan \alpha \frac{I_v}{I_u}$$

In the case of the 8-in. channel considered, it is equal to —12.143, from which θ = 85 deg. 18 min. The deflection will be in a direction perpendicular to the neutral axis.

It is seen from the table that the maximum fiber stress increases with the slope of the roof. If purlins were proportioned for this fiber stress they would often be much larger than those commonly used. The recently issued Part 3 of Johnson, Bryan and Turneaure's "Modern Framed Structures" furnishes an example. In designing purlins for a 6-in. pitch roof with trusses 15 ft. apart and No. 20 corrugated steel covering, the authors require 8-in. 18-lb. I-beams spaced 4.2 ft. apart. In practice 6-in. channels with tie rods are used.

USE OF TIE RODS

It is also seen that the increase in fiber stress is due to the second term of the general equation and that this term must be reduced or eliminated to bring the fiber stress within reasonable limits. This is accomplished partly by the stiffness of the roof covering and partly by the use of tie rods between purlins, both of which tend to prevent deflection of the purlin in the plane of the roof.

The indeterminate part of the problem is the value to be assigned to the stiffness of the roof covering. In plank or concrete roofs, tie rods are used mainly to keep the purlins in line during erection. A roof covering of sheet metal or loose tiles has little stiffness and the component of the load along the plane of the roof must be taken by tie rods. For a sheet-metal covering a load of 25 lb. per square foot of exposed surface is usually sufficient for the weight of purlins, covering and snow. This acts vertically, and for a 6-in. pitch roof the component along the plane of the roof is 25 lb. × sin 26° 33′ 54″ = 11.88 lb. The wind pressure, being normal to the roof, does not affect the tie rods.

Sizes of Tie Rods

The net area of a ⅝-in. round tie rod at the root of a thread is 0.202 sq. in., and with tension at 16,000 it is good for a pull of 3232 lb. A ⅝-in. tie rod is thus sufficient for 272 sq. ft. of roof surface on a 6-in. pitch roof. A ¾-in. rod is sufficient for 407 sq. ft. If the roof covering is of "Bonanza" tile or similar material the vertical load will be about 35 lb. per square foot. A ⅝-in. tie rod will then be found sufficient for a roof surface of 208 sq. ft. and a ¾-in. rod for 310 sq. ft.

Table 2.—Ratio of Maximum Fiber Stress to Bending Moment for Vertical Loading on Z-Bars and Angles

	Pitch of roof in inches per foot.								
Purlin.	0	1	2	3	4	5	6	7	8
3 x 1/4 Z	1.49	1.39	1.27	1.14	1.02	0.89	0.78	0.66	0.55
3 x 5/16 Z	1.20	1.12	1.03	0.93	0.83	0.74	0.63	0.54	0.48
4 x 1/4 Z	0.87	0.80	0.71	0.63	0.53	0.47	0.39	0.32	0.28
4 x 5/16 Z	0.71	0.65	0.58	0.52	0.44	0.39	0.32	0.26	0.22
5 x 5/16 Z	0.49	0.44	0.39	0.34	0.28	0.23	0.18	0.20	0.24
5 x 3/8 Z	0.41	0.37	0.33	0.28	0.24	0.20	0.15	0.16	0.20
6 x 3/8 Z	0.30	0.27	0.23	0.20	0.16	0.12	0.13	0.16	0.19
6 x 7/16 Z	0.26	0.24	0.20	0.17	0.14	0.11	0.11	0.13	0.16
2½ x 2 x 1/4 L	3.49	3.30	3.11	2.88	2.68	2.46	2.30	2.14	2.01
2½ x 2 x 5/16 L	2.91	2.76	2.61	2.41	2.22	2.04	1.90	1.78	1.67
3 x 2½ x 1/4 L	2.33	2.22	2.10	1.98	1.85	1.71	1.60	1.49	1.38
3 x 2½ x 5/16 L	1.89	1.83	1.73	1.63	1.51	1.41	1.30	1.24	1.15
3½ x 2½ x 1/4 L	1.80	1.69	1.60	1.46	1.35	1.22	1.15	1.06	1.12
3½ x 2½ x 5/16 L	1.47	1.39	1.31	1.22	1.14	1.02	0.96	0.89	0.93
4 x 3 x 5/16 L	1.06	1.00	0.94	0.88	0.81	0.75	0.69	0.65	0.66
4 x 3 x 3/8 L	0.92	0.87	0.81	0.75	0.70	0.63	0.59	0.55	0.52
5 x 3½ x 5/16 L	0.68	0.65	0.61	0.56	0.51	0.47	0.43	0.41	0.48
5 x 3½ x 3/8 L	0.60	0.57	0.53	0.48	0.43	0.40	0.37	0.35	0.41
6 x 4 x 3/8 L	0.41	0.38	0.35	0.32	0.29	0.27	0.25	0.27	0.30
6 x 4 x 7/16 L	0.35	0.33	0.31	0.28	0.25	0.23	0.22	0.23	0.26

It is important that the ties extend over the ridge of the roof, or where this cannot be done that the uppermost ties run diagonally to the roof truss. Theoretically ties are seldom needed where the slope is less than 3 in. to 1 ft. Roofs of this pitch are generally of plank or concrete and are sufficiently stiff when in place to prevent the purlins from bending in the plane of the roof. It is, however, excellent practice to use ties for erection purposes.

Table for Z-Bars and Angles

Table 2 gives the maximum fiber stress in decimal parts of the bending moment for Z-bar and angle purlins. As with beams and channels, the purlins are assumed at right angles to the rafter with the top flange projecting toward the ridge of the roof. In all purlins the vertical load is considered to be applied at the center of gravity of the cross-section. Z-bars and angles are seldom used for purlins, and it is difficult to obtain Z-bars except in large quantities.

The calculations and tables of this article have been checked by the writer's colleague, Stanley Smith.

New Tests Indicate Flow of Concrete Under Sustained Load

Earl B. Smith Reports Results for Cylinder and Beams—Flow Continues at Decreasing Rate, Becoming Very Small After a Few Weeks

SUPPLEMENTING the tests reported last year (see the Engineering Record of March 4, 1916, page 329) Earl B. Smith, associate mechanical engineer, U. S. Office of Public Roads, Washington, D. C., reported at the last annual meeting of the American Concrete Institute the results of new tests of concrete cylinders and beams. These tests indicate that gravel concrete has about 20 per cent more flow than limestone concrete. Values of the modulus of elasticity were found to decrease with time, and the flow is shown to continue at a gradually decreasing rate. It is an appreciable amount during three to four weeks, after which the additional change is very small.

The word flow, Mr. Smith states, is not used in the sense of fluidity but in the sense of molecular displacement or rearrangement under the influence of an external force. It is the gradual but persistent deformation which takes place in the material under sustained stress. This flow or continual deformation is not all permanent set but is partly elastic, the recovery being 25 to 50 per cent of the total deformation. The term "time yield" has also been properly used to designate and describe this phenomenon.

Flow should not be confounded with shrinkage. Both factors exist in all concrete and are easily distinguished. Shrinkage exists as a natural consequence, regardless of the size, position or stress, and is influenced mostly by age and moisture. Flow, however, exists by virtue of sustained stress. It is a time-stress effect. Flow and shrinkage are distinguished by means of deformation readings on loaded and unloaded specimens, as has been done in the tests here described. The curves shown are for the net flow values only.

Compression Tests on Cylinders

Concrete cylinders of 1:2:4 mix, 3 in. in diameter and 24 in. long, were loaded to 840 lb. per square inch by a dead load applied through an I-beam as a lever. Gravel and limestone were used for the large aggregate, and

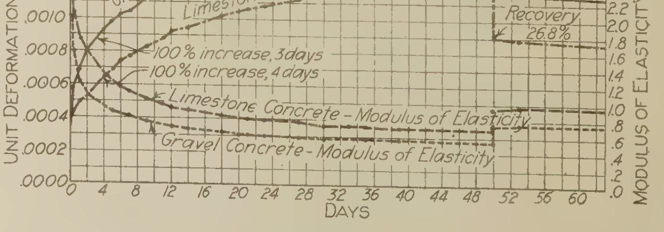


FIG. 1—FLOW OF CYLINDERS UNDER CONSTANT COMPRESSION STRESS

companion cylinders were prepared for use without loading. In this way the contraction or shrinkage data for correcting the deformation of the loaded cylinders were obtained, thus giving the net flow deformation due to the load. The deformations were measured periodically by a Berry 20-in. strain gage. These cylinders were all cured in the open air, and sprinkled once each day for the first week. The load was then applied after aging 28 days.

The results are given in Fig. 1. The flow is relatively great within the first week. The deformation increases 100 per cent in four or five days, and requires nearly four times as long to increase another 100 per cent. Particularly noticeable is the fact that the flow of gravel concrete is considerably greater than limestone concrete, yet the recovery is approximately the same. This relative flow of concrete as influenced by the character and kind of aggregate should be further investigated. The modulus of elasticity of these two specimens is shown by the two lower curves.

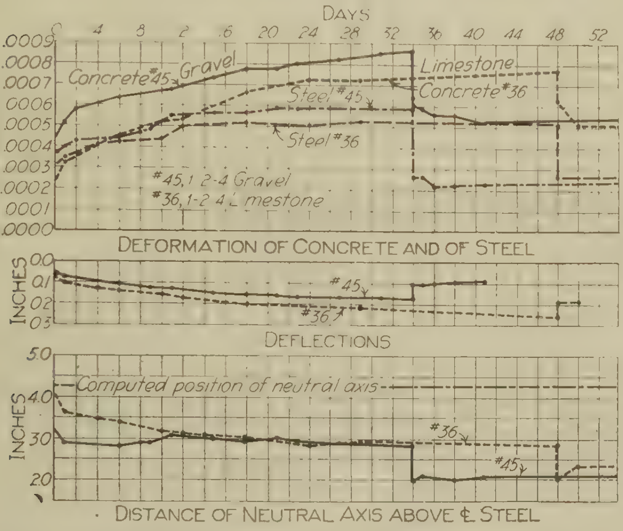


FIG. 2—REINFORCED-CONCRETE BEAM DEFORMATIONS UNDER FIXED LOAD

Reinforced-Concrete Beam Tests

Two 5 x 8-in. reinforced-concrete beams were cast, and at the age of four weeks were each placed on two supports of 10-ft. clear span and loaded at the center with a concentrated load of 830 lb. The effective depth was 7 in., and the reinforcement amounted to approximately 0.75 per cent, consisting of two plain 3/8-in. square bars. The concrete in each case was 1:2:4 mix—gravel for one beam and limestone for the other. Companion sections were cast of each mixture from which to obtain the contraction or shrinkage data.

The results of these tests are shown in Fig. 2. The upper group of four curves shows the net flow in concrete and the increase of stress in the steel. The middle group of two curves shows the deflection of the beams. The lower curves show the change in the position of the neutral axis.

The load was sustained on the gravel beam for 34 days and on the limestone beam for 48 days, and then completely removed. The concrete showed an elastic recovery after two days of 24 per cent for the gravel beam and 29 per cent for the limestone beam. The steel has apparently recovered approximately its original condition before loading. The partial recovery of the position of the neutral axis should be noticed. This position was computed by means of the extreme compressive deformation values in the concrete and the tensile deformation values in the steel, assuming a straight-line variation.

The law of the flow of concrete is asymptotic. The flow continues at a gradually decreasing rate, and yet is an appreciable amount during three to four weeks. It then occurs more slowly for an indefinite period; but this additional change is very small. The natural total shrinkage of dry concrete is about 0.05 per cent in three months. The total net flow under load, exclusive of the natural shrinkage, may be as great as 0.15 per cent, depending on the time, material and load. The total combined effects of the shrinkage and flow in compression may amount to as much as 0.2 per cent. This would give in a 20-ft. column not reinforced, if loaded to about 800 lb. per square inch, nearly ½ in. deformation, and may produce in a reinforced beam of 20-ft. span fully loaded a sag of nearly 0.3 in. Even the much smaller deformations, which are inevitable, may produce serious results in the setting of apparatus and machinery and in the alignment of shafting, and may easily cause other parts and members of the structure to be overloaded.

Measurement of Stress Conditions

The measurement of stress conditions in concrete structures cannot be made directly by deformation readings unless all the flow constants as to time, material and loading are known. It is readily seen that deformation readings taken only a short time apart will indicate apparently different stress values.

The magnitude of the flow deformations varies quite largely with the kind of aggregate and the mixture. For instance, it is shown in these experiments that gravel concrete has about 20 per cent more deformation than limestone concrete.

The modulus of elasticity of concrete is different for each mixture and for each different aggregate. It changes and decreases in value with time and as the flow deformations increase. If the modulus of elasticity could be ascertained for any particular concrete with due respect to the time factor, stress values could then be determined by simple deformation readings.

In the case of a reinforced beam, the effect of flow in the concrete is to lower the position of the neutral axis, thus enlarging the compressive area, relieving the unit stress in the concrete and throwing more stress into the steel.

Construction Activities in Philippine Islands Increase During 1915

During 1915 approximately 310 miles of first-class road was constructed in the Philippine Islands. This is an increase of 51 per cent over this kind of work completed in 1914. Reinforced-concrete bridges and culverts completed total 371—an increase of 26 per cent over the preceding year, according to the annual report of the Philippine Commission recently issued. One hundred and thirty-nine deep wells have been completed—an increase of 35 per cent over 1914. The increase in reinforced-concrete building work is only 2 per cent; the number of such buildings completed during the year totals 127.

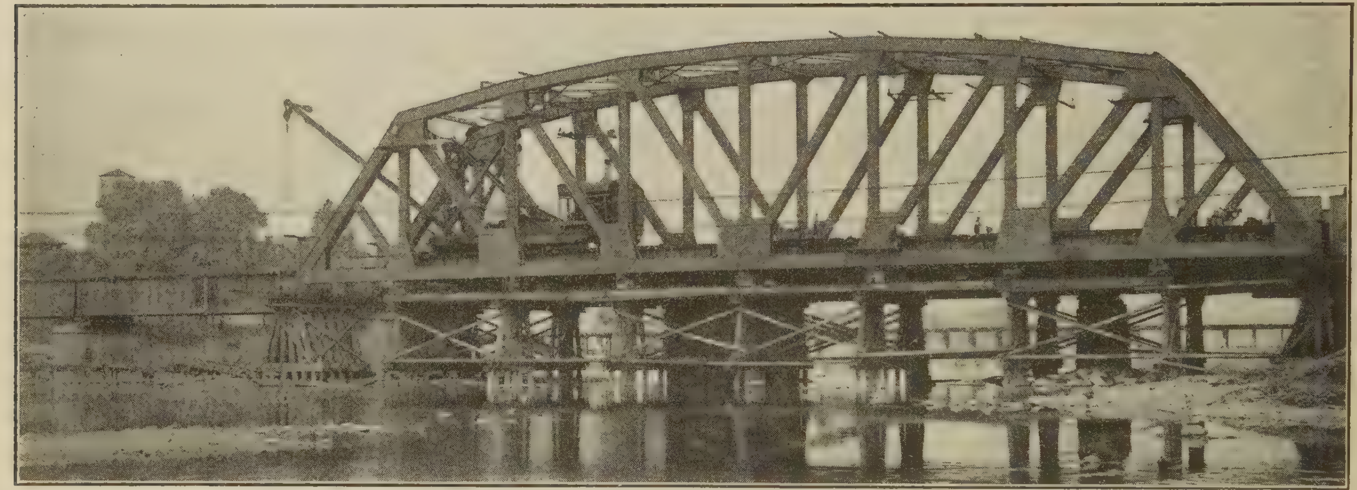
Shift Three Truss Spans in Two Moves to Replace Old Girders

Less Than Two Minutes Required for Each Move of Bridge Over Miami River at Dayton—Heavy Double-Track Traffic Preserved

IN RECONSTRUCTING the superstructure of the Dayton Bridge over the Miami River, which is used by all the railroads entering that city, a unique problem was encountered by the contractor. The problem was complicated by the requirement that heavy double-track traffic must be preserved practically without interruption, by the fact that the three new truss spans and new masonry and the old girder spans and masonry did not match up, and by the close proximity to the freight yard and Union Depot, which made it impossible to shift the main tracks laterally and thus allow complete temporary transfer of traffic to the new bridge while removing the girder spans.

After discussing various plans, it was found practicable to erect the three new 223-ft. spans on the downstream side of the old bridge, and by using one track of the new bridge and one of the old the downstream girder spans could be removed and the new spans pulled over 16 ft., the tracks being shifted to proper alignment on the approaches, both tracks of the new spans then being used, while the upstream girder spans were picked up by derrick cars and backed out. The final move of the new trusses then brought them into position coinciding with the old position of the tracks. Each move required less than 2 minutes, all three spans being shifted at once.

The old bridge, consisting of seven deck plate-girder spans 90 ft. long, was built about 1908 and designed to carry Cooper's E-50 loading, using independent single-track girder spans. The flood of March, 1913, washed out old pier 4 entirely and tipped pier 5, and from that time until work on the substructure of the new bridge was begun trains were operated over the replaced girder spans carried by pile bents. When the Conservancy Commission required increased waterway and the removal of obstructing piers (the old girder spans really acting as a dam in times of flood), a new structure was designed of three through curved-chord truss spans of equal length, requiring only two intermediate piers. These piers and the new abutments were constructed by the Foundation Company of New York City, after the old girder spans had been shifted, as noted on one of the drawings, in order to allow free access to the site of the new work. A description of this work will be found in the Engineering Record of April 22, 1916, page 548. The erection of the superstructure on falsework located on the downstream side of the old spans was begun about June 1, 1916, the first shift of 16 ft. laterally was made on Dec. 4 and the final shift of 14 ft. 6 in. on Dec. 27, 1916.



NEW SPANS ERECTED ON TIMBER BENTS ON DOWNSTREAM SIDE OF OLD GIRDER SPANS

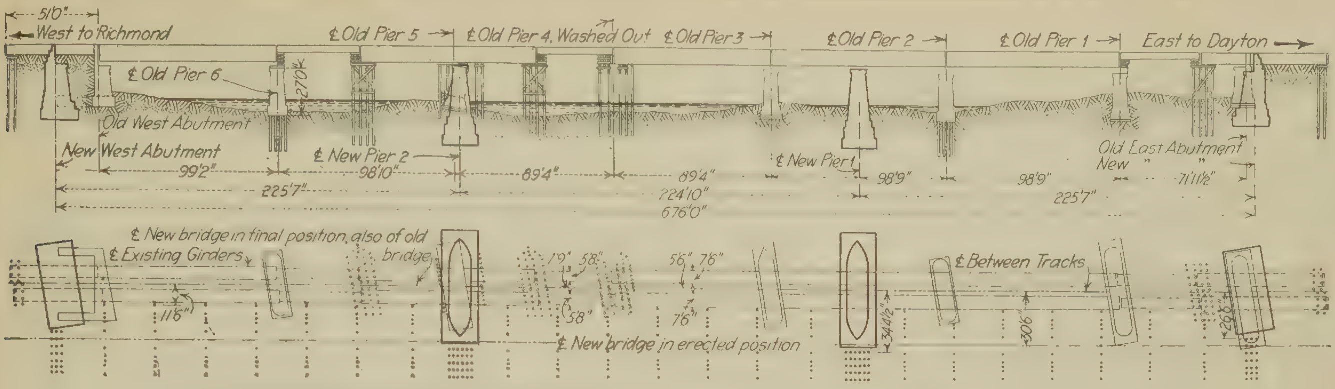
THREE NEW SPANS 223 FEET LONG

The new riveted steel spans, of the through Pratt type with curved upper chords, are 221 ft. 4 in. long center to center of end pins. They consist of eight panels of 27 ft. 8 in. each, and are 44 ft. deep at the center and 35 ft. at the hip vertical. The trusses, built for double-track Cooper's E-60 live loading, are spaced 31 ft. apart on centers. The distance from base of rail to center of lower chord is about 5 ft., and to mean low water is about 30 ft. The new piers and abutments are square instead of skew as in the old bridge. The bridge seats are 7 ft. wide on the abutments, and the tops of the piers are 9 ft. wide.

The masonry for the new spans, as indicated in the plan and elevation herewith, bears little direct relation to the supports of the old spans, in the sense that the replacement operation might be carried out as is usual in cases where new spans are to replace old ones without interruption of traffic—that is, by roller nests on the piers and abutments to allow simultaneous shifting of both the old and the new spans. This difficulty was increased by the still further complication of spans introduced by the shifting of the old girders and use of shorter girder spans carried on pile bents to clear the foundation work.

NEW SPANS ERECTED ON FALSEWORK

The first operation in the reconstruction of the superstructure was the erection of each of the three duplicate steel spans on falsework on the downstream side. Details of the typical intermediate bents and of the pile-bent extensions to the new piers, shown in the drawings, indicate that the intermediate bents were built of two separate units each, and thus could be easily dismantled



PLAN AND ELEVATION SHOW RELATIVE POSITION OF OLD AND NEW MASONRY AND LOCATION OF PILING

after one span was swung and carried by derrick car to the next span. In erecting the lower chords the spliced joints were all riveted up complete from end to end with the chord in a horizontal position, then the panel points were jacked up to the exact computed elevation given for the field erection to allow for camber, strains from dead and live loads and settlement of falsework. In this way the square joints properly abut, local stresses at the splices are avoided and a true curved chord for camber is obtained.

NEW SPANS ERECTED ON DOWNSTREAM SIDE

The new spans were erected with the center line 30 ft. 6 in. from the center line of the old bridge, a figure obtained by allowing the required 7-ft. clearance from the center line of the downstream track to the steel of the new trusses. The erected position was 2 in. higher than the final position. As heavy end floorbeams were used in the design, they could be utilized to carry the full dead load of the span. Each bridge was therefore swung by blocking up under the end floorbeams, as indicated by one of the drawings. The spans were thus carried on the roller tracks, consisting of 100-lb. rails with 2½-in. rollers between them.

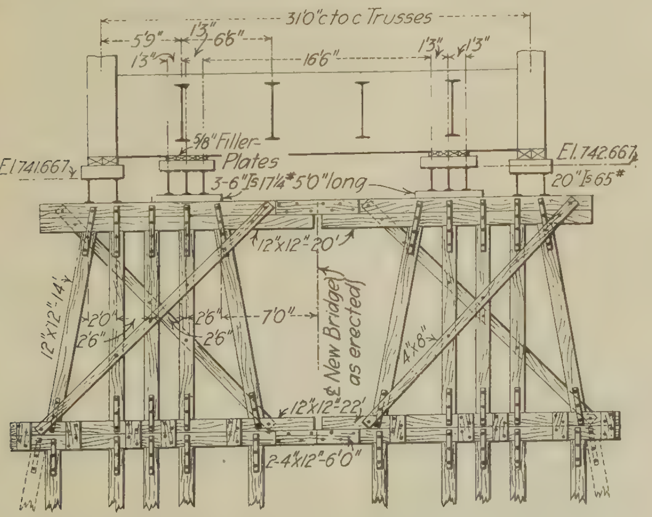
As the end pedestals interfered with the roller details, they were not inserted until the bridge was placed in its final position. This was the reason for erecting the trusses 2 in. higher than the final position, to allow these pedestals to be slipped in and the span lowered to its bearing upon them. After swinging the span on the end floorbeams, blocking was built up under the end lower chords, and these were wedged up to carry the live load for temporary operation when one track was used, as described later.

In order to prepare for the first move of the new spans and insure double-track operation at all times, the eastbound traffic had to be diverted before the existing downstream girder spans could be removed. Furthermore, to make the first shift of the spans as great as possible, and also to align the tracks on the approaches, the upstream girder spans were shifted 2 ft. 6 in. upstream by the use of derrick cars, as far as the piers and abutments allowed. The traffic on the old downstream track was then diverted to the upstream track of the new spans by connecting up with a temporary approach track 17 ft. 6 in. from the center of the permanent eastbound track.

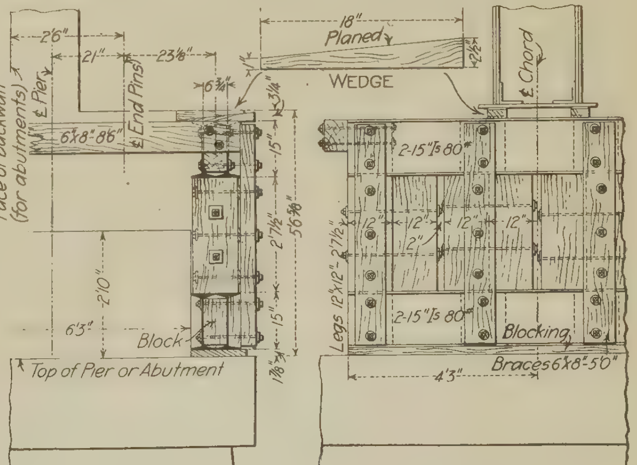
OLD GIRDER SPANS REMOVED BY DERRICK CAR

The old 90-ft. girder spans on the downstream side—each girder weighing about 36 tons—were then removed by picking them up with a derrick car, using a special auxiliary boom 67 ft. 6 in. long attached to the standard car. Beginning at the west end, these girder spans were carried successively to the east end, where they were loaded on cars in the freight yard. The approach tracks were then shifted downstream 1 ft. 6 in., so that they would line up with the upstream track on the new span after it was shifted.

The actual operation of shifting the three new spans upstream 16 ft. on the rollers was carried out in less than 2 minutes. Two derrick cars were run on the down-



INTERMEDIATE BENTS OF TWO UNITS EACH FOR NEW SPANS PLACED NEAR EACH PANEL POINT



END VIEW OF PIER

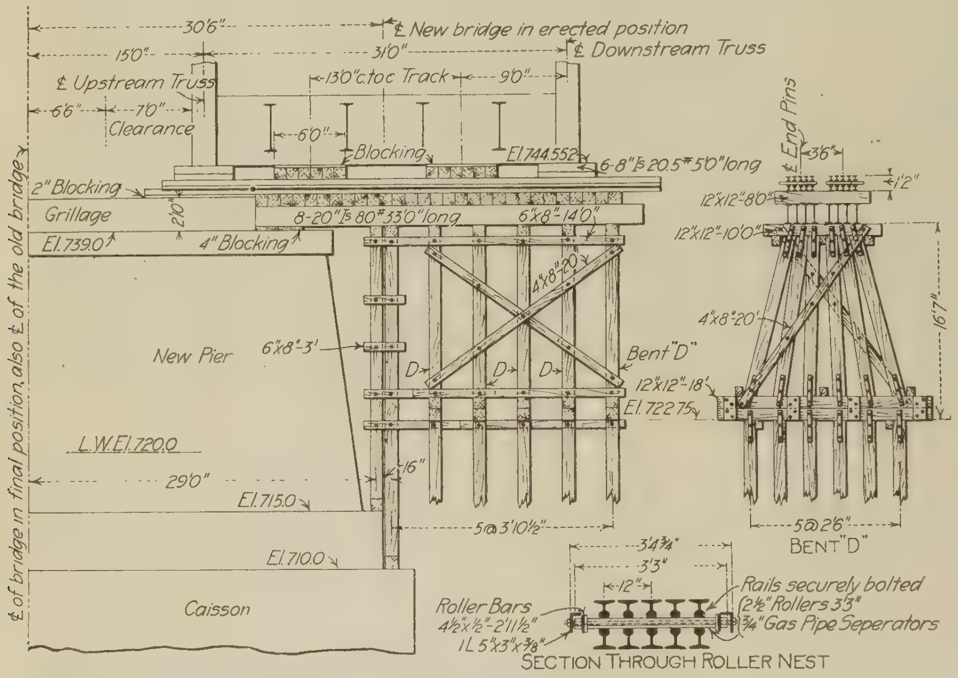
SIDE ELEVATION

JACKING GIRDERS DISTRIBUTE LOAD AT THE EDGE OF MASONRY stream track of the central span and linked together. About 35 ft. upstream from the center line of the old bridge, and of the new spans in their final position, four deadmen, consisting of two piles each, were driven, and ¾-in. wire rope attached to the upstream ends of the truss spans, passed over sheave blocks at these four points and by right-angled turns at the end floorbeams were carried to drums on the derrick cars. A telltale near the center of the center span indicated the position of each of the moving spans.

The total weight moved was more than 2900 tons, consisting of 2427 tons for the trusses, 300 tons in the floor and 180 tons for the two derrick cars. The advantages in using the derrick cars on the moving trusses are in the central control, the foreman at the telltale easily giving orders to the enginemen, and in the simpler arrangement of sheave blocks, avoiding the application of active external forces.

SECOND MOVE 14 FEET 6 INCHES

After the truss spans had been shifted 16 ft. upstream, the downstream track of these spans was brought into operation by shifting the tracks on the approaches 3 ft. upstream to alignment. The old upstream spans were then abandoned and removed as in the previous case. The piers were now free for the final shift of the new spans, which was accomplished as before, rolling a distance of 14 ft. 6 in. in less than 2 minutes without a hitch. The approach tracks were then shifted back to the old alignment, the centers of tracks on the new bridge coinciding with the old centers on the girder spans.



FALSEWORK AT PIERS CARRIES RAIL TRACK FOR ROLLING NEW SPAN

After the new spans had been rolled to final position, they were still 2 in. high, and the problem of lowering them to bearing on their pedestals on the new masonry was solved economically without the use of outside falsework. This was accomplished by four 500-ton jacks placed between the position of the pedestal and the inside blocking and working on jacking girders on the extreme edge of the masonry, as indicated in the details shown in one of the drawings. The track rails had been arranged by splicing in such a manner that the outside sections could be removed to allow the pedestals to be placed. Then the inside blocking was cut out and the end of the span slowly jacked down to bearing on the shoes.

The details of the methods used were worked out by S. P. Mitchell, president of the Seaboard Construction Company of Philadelphia, the contractor for the erection. The bridge is owned by the Pennsylvania system and the Baltimore & Ohio jointly, and J. C. Bland, engineer of bridges of the Pennsylvania Lines West of Pittsburgh, had general supervision of its reconstruction. H. S. Goodloe was superintendent of the construction forces.

How Wyoming's Ten-Year-Old License Law Is Working

State Engineer Holds That Regulation by Law Is a Success and Increased Standing of the Profession Has Been Obtained

NEARLY 300 licenses for engineers in Wyoming have been issued for one of the five grades provided by the engineers' license law ten years ago, although only 236 are now in good standing. During the two-year period covered by the biennial report of the state engineer, James B. True, who is also secretary of the Board of Examiners, twenty-three licenses have been granted. Three men failed to pass, four applications are pending and three licenses were revoked. Mr. True states that the law is a success and that the standard has been gradually raised by examinations, which are now somewhat more difficult than those originally given.

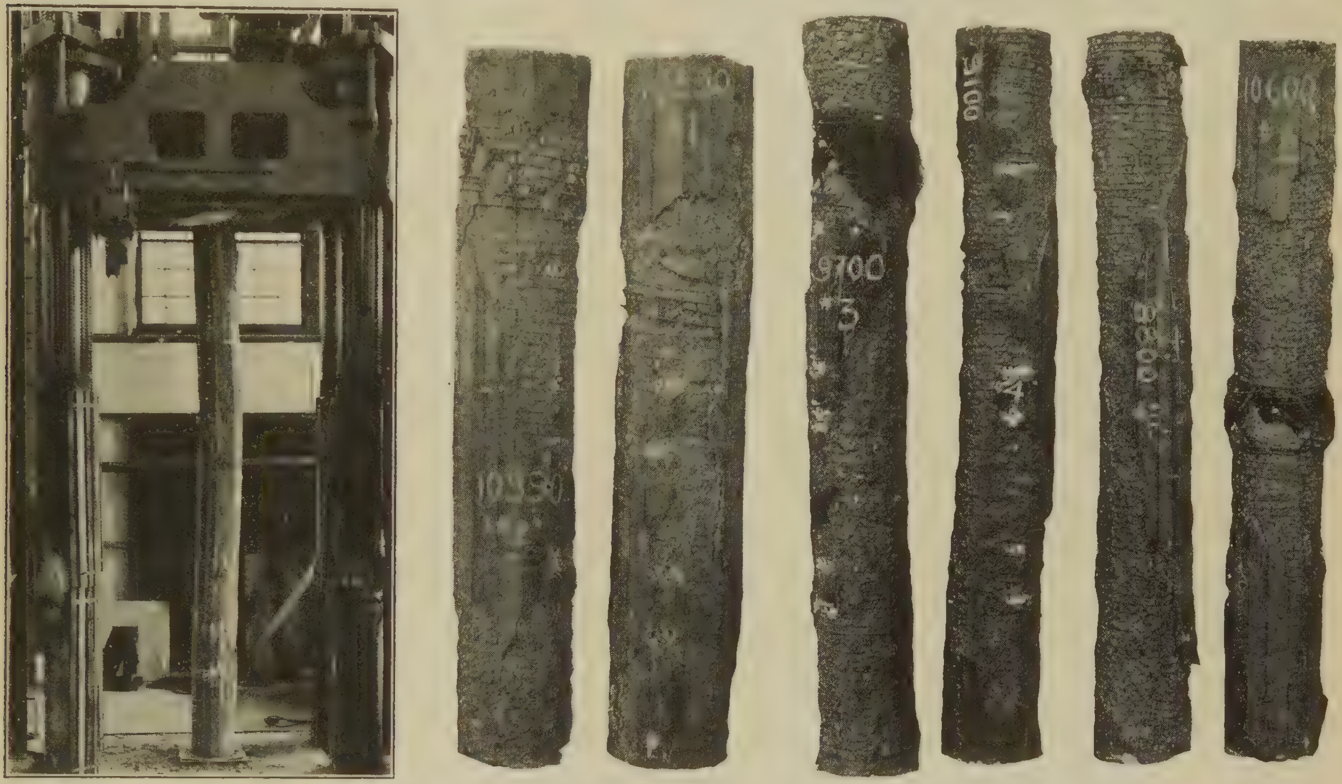
The first-grade license covers plane surveying only, but the holder is also authorized to lay out irrigation works for the reclamation of not more than 1000 acres, or to design reservoirs when the depth of water to be stored is not greater than 10 ft. The second-grade licensee may in addition survey rights-of-way, while the third-grade holder may do hydraulic engineering work, such as measurement of the discharge of streams and ditches and the planning of any hydraulic work costing less than $7,500, or reclaiming less than 1000 acres. The fourth-grade field embraces all other engineering work relative to the utilization or use of water, and the fifth indicates that the engineer is authorized to practise in any lower grade and that he has a knowledge of the irrigation laws of the state as well as of the court decisions interpreting that law.

The distribution according to grades is as follows: One, 72; two, 52; three, 30; four, 60, and five, 22.

Test Hooped Concrete Columns with Cast-Iron Cores

Emperger Columns Tested at U. S. Bureau of Standards Reported by L. J. Mensch for American Concrete Institute

THAT cast-iron cores of cylindrical or I-section add greatly to the strength of concrete columns hooped with spiral steel reinforcement is shown by the results of tests made in November and December last year at the U. S. Bureau of Standards, under the direction of P. H. Bates, using the 10,000,000-lb. testing machine in Pittsburgh. In a paper written for the American Concrete Institute, L. J. Mensch, of Chicago, who is the American representative for the Emperger column, reports the results of these tests and gives tables and diagrams not only for the twenty columns tested in this series but for previous European tests on similar columns. The abstract which follows includes the more important parts of Mr. Mensch's paper and the general results for the 1916 tests.



TYPICAL FAILURES OF CONCRETE COLUMNS REINFORCED BY CAST-IRON CORE AND STEEL HOOPING

ORIGIN OF COLUMNS

The invention of hooped cast-iron columns by Dr. F. von Emperger will allow in the future more reasonable sizes of columns in tall and heavy buildings. About eight years ago Dr. Emperger tested steel columns stiffened by concrete. He found that the concrete did stiffen the steel columns, but that the flow of the steel members after the elastic limit was reached destroyed the concrete and placed a limit on the strength at a unit deformation of about 0.001 in. He then conceived the idea that cast iron, with its much greater compressive strength, reinforced with hooped concrete, would make a more suitable column. It is noteworthy that concrete reinforced with longitudinal steel rods fails at a unit compression rarely exceeding 0.0015, and is therefore not suitable to help cast iron with its low modulus of elasticity. Hooped concrete, however, can stand much greater deformations without failure, and the combination of hooped concrete and cast iron makes it possible to develop the ultimate strength of both the hooped concrete and the cast iron.

The diagram here reproduced shows the stress-strain curves for plain and hooped concrete, for various grades of cast iron, and for mild steel. The stress-strain curve for plain concrete ends at a unit deformation of 0.0015 in. per inch of length, at which deformation cast iron is stressed only 15,000 to 25,000 lb. per square inch. The curves for spirally hooped concrete end at much larger unit deformations, and the larger the spiral reinforcing the larger the unit deformation which the concrete can maintain without failure. At a unit strain of 0.01 cast iron of ordinary quality will develop stresses of from 45,000 to 50,000 lb. per square inch, while high-grade cast iron such as Dr. Emperger used will develop stresses over 80,000 lb. per square inch, provided the column does not fail in bending. The diagram further shows that mild steel cannot develop much more than 37,000 lb. per square inch in the most favorable case in combination with concrete, with or without spiral hooping.

DESCRIPTION OF TEST COLUMNS

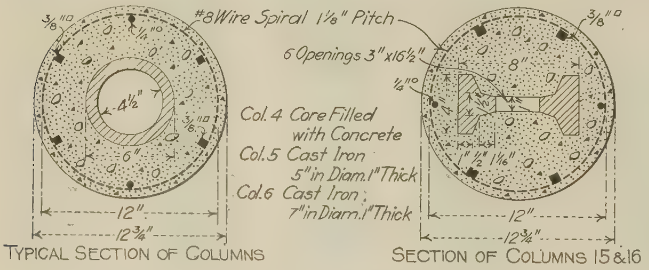
To verify these theoretical deductions, Mr. Mensch, in September and October of last year, made twenty columns about 12 in. diameter and from 6 to 14 ft. long. Concrete was a 1:1:2 mix, and the dimensions and reinforcement are given on the diagram accompanying the table of results reproduced herewith. With each batch one 6 x 12-in. concrete cylinder was made, and tested at the age of 62 to 66 days, when the columns were tested. Universal Portland cement, good clean washed torpedo sand, and gravel passing a 1-in. ring and with particles varying from ⅜ in. up were used. The spiral steel, furnished by the American System of Reinforcing, was high-carbon wire, fastened on opposite sides to ¼-in. round vertical rods. The vertical square deformed bars were also of high-carbon steel, wired to the spiral at about 1-ft. intervals.

CAST-IRON CORES

The column cores were made by the American Building Foundry Company, of Chicago, of a mixture of 50 per cent gray iron and 50 per cent scrap. Test cubes of 1-in. sides showed a stress of 100,000 to 150,000 lb. per square inch, but the actual castings as typified by a 5-in. column 24 in. long showed only an ultimate strength of 72,700 lb. per square inch and an initial modulus of elasticity of 10,000,000.

The cast-iron columns varied only about ⅛ to 3/16 in. in thickness where the core was supported by chaplets, and between this point varied as much as ½ in. in thickness. The column ends were machined in the foundry. The sections were often 10 per cent weaker than the theoretical section.

In order to make extensometer readings for vertical deformations, holes were cut in each column adjoining vertical rods at diagonally opposite sides and at the quarter points along the columns. In these holes ⅜-in. round iron plugs were fastened. Punch marks were made in these plugs, also in the adjoining ⅜-in. square bars, from which the extensometer readings were taken by means of a 6-in. Berry gage. Besides the extensometer readings at the twelve points 6 in. center to center, three vertical extensometer readings, called A, B and C, were taken on each column for distances within 1 or 2 ft. of the length of the column. The apparatus for these latter measurements consisted of two iron rings fastened by screws to the columns at about the correct distance. The upper ring carried three brass tubes about ¾ in. in diameter which rested, by means of needles, on the gage fastened to the lower ring.


⅜"□
#8 Wire Spiral 1⅛" Pitch
¼"○
4½"
⅜"□
6"
12"
12¾"
6 Openings 3"x16½"
Col. 4 Core Filled with Concrete
Col. 5 Cast Iron 5" in Diam. 1" Thick
Col. 6 Cast Iron; 7" in Diam. 1" Thick
⅜"□
¼"○
8"
4"
1" ½" 1¹⁄₁₆"
12"
12¾"

TYPICAL SECTION OF COLUMNS

SECTION OF COLUMNS 15 & 16

While the extensometer readings on the 6-in. gage length are often erratic, due to local conditions, the readings at the points A, B and C were comparatively very uniform. The extensometer readings were taken after the pump was stopped, and owing to the plasticity of the column the load slightly dropped off during the five minutes it took to make fifteen readings. From the few tests to determine the drop, it is believed that it did not amount to more than 1 per cent.

RESULTS FOR COLUMNS WITHOUT CAST-IRON CORES

For the hooped concrete columns without cast-iron reinforcement the first crack occurred at an average load of 465,000 lb., or 4110 lb. per square inch, while the concrete cylinders failed at an average of 3630 lb. per square inch. After the first crack the columns compressed faster and the maximum load was evidently reached when the spiral reinforcing was near its ultimate strength. The average maximum load was 540,350 lb., or 4778 lb. per square inch, which agrees very well with the formula proposed by the National Concrete Institute.

In order to find out how much the cast iron carried in the other columns, the assumption was made that 4778 lb. per square inch was the strength of the concrete within the core and that the remaining load was supported by the cast-iron column.

RESULTS FOR COLUMNS WITH CAST-IRON CORES

The ten columns with cast iron reinforcement, 8 to 12 ft. long, showed very uniform results, as indicated by the table. Only in column 3 appeared the first crack at

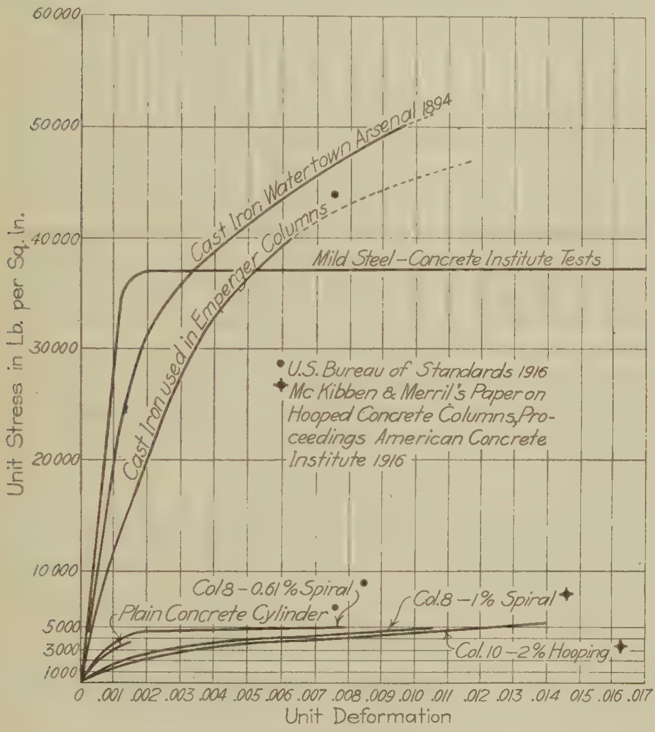
Table of Results—Tests of Emperger Columns, United States Bureau of Standards, 1916

Col. No.	Length, feet	Actual area of concrete within core, sq. in.	Area of vert. steel, sq. in.	Area of cast iron, core, sq. in.	Ratio cast iron to concrete, per cent	TOTAL LOAD IN POUNDS: At first crack	Maximum	Average carried by concrete	Average carried by cast iron	Average unit load on cast iron, pounds per sq. in.	VERTICAL UNIT STRAIN: At ¼ max. load	At max. load	Ultimate strength 6x12-in. concrete cylinders, lb. per sq. in.
1	6	84.8	0.66	12.37	14.6	436,500	1,057,000	1,041,400		51,500	0.00042	0.0083	4300
2	6	84.8	0.66	12.37	14.6	776,000	1,026,000	405,000	636,500		0.00040	0.0090	4300
3	8	84.8	0.66	12.37	14.6	436,500	940,000	405,000	535,000	42,700	0.00034	0.0115	3750
4	8	100.7	0.66	12.37	14.6	570,000	1,031,500	481,150	550,350		0.00052	0.0080	3750
5	8	93.5	0.66	12.57	13.4	679,000	925,000	446,600	478,400		0.00035	0.0074	4150
6	8	74.6	0.66	12.52	16.8	565,500	920,000	356,300	563,700		0.00037	......	4150
7	10	113.1	0.66	......	......	490,000	518,500	540,350	....	....	0.00025	......	3890
8	10	113.1	0.66	......	......	440,000	562,200				0.00022	......	3370
9	8	....	....	12.37	....	....	480,000	....	510,000	41,200	....	......	....
10	8	....	....	12.37	....	....	540,000				....	......	....
11	10	84.8	0.66	12.37	14 6	643,500	911,000				0.00035	......	3750
12	10	84.8	0.66	12.37	14.6	650,000	940,000	941,375			0.00035	......	3750
13	10	84.8	1.22	12.37	14.6	776,000	896,000	405,000	536,375	43,400	0.00034	......	
14	10	84.8	1.22	12.37	14.6	727,500	1,066,500				0.00045	......	
15	10	99.7	1.22	13.40	13.4	850,000	1,071,800	1,009,900			0.00036	......	
16	10	99.7	1.22	13.40	13.4	576,000	996,000	476,360	533,540	41,600	0.00036	......	4250
17	12	84.8	0.66	12.37	14.6	732,500	951,500	930,250			0.00037	0.0070	
18	12	84.8	0.66	12.37	14.6	630,500	909,000	405,000	525,250	42,400	0.00041	0.0060	
19	14	84.8	0.66	12.37	14.6	630,500	888,500	858,000			0.00038	0.0100	
20	14	84.8	0.66	12.37	14.6	679,000	827,500	405,000	453,000	36,650	0.00033	0.0064	4400

Columns and cylinders were 62 to 66 days old when tested. Concrete 1: 1:2.

the low load of 436,000 lb. or about one-half the maximum load; in all other cases the first crack was noticed at loads of 600,000 to 800,000 lb., or at 0.6 to 0.8 of the maximum load. The unit deformation at this time varied from 0.00125 to 0.00175—practically the same as for plain concrete cylinders at failure.

At a load of about 800,000 lb. considerable spalling of the outer shell occurred. Sometimes the spalling started at the top or bottom, or it might start in the center, clearly indicating that the cast-iron column carried the stresses over the weak spots in the concrete. Near the ultimate load sometimes one or two spirals burst, but still the cast-iron column helped to distribute the load, and spirals often burst in quite distant places.



STRESS-STRAIN DIAGRAM—CAST IRON, STEEL AND CONCRETE

When the pump was working after the maximum load was reached, the concrete where the spiral burst was destroyed and after a few minutes fell out and exposed the cast iron. Even then the cast iron probably carried 80 per cent of the maximum load. In two cases where the pump was not kept running perhaps ten minutes after the maximum load was reached and the cast iron was exposed for about 6 in., circular cracks appeared around the columns about 12 in. on centers, which showed the tendency of the cast iron to transmit the load by bond again into the undamaged part of the concrete.

In column 4 the cast-iron core was filled with concrete and showed a gain proportionate to the extra concrete.

The cast-iron cores for columns 13 and 14 were spliced 3 ft. from one end. The average load carried by these two columns was 981,000 lb., while columns 11 and 12 averaged only 925,500 lb. Columns 13 and 14 had 0.6 sq. in. of extra vertical steel, which would account for not more than 24,000 lb.; so that it may safely be stated that splices do not diminish the strength of such columns.

Columns 15 and 16 had I-sections of reinforcement, as shown in the drawing. The object was to find whether a smaller radius of gyration in one direction can be counteracted by the stiffness of the concrete. These columns carried practically the same unit stresses as columns 11 and 12 with round cast-iron cores. Such sections may be of advantage in cases where continuous concrete girders are attached to the columns, giving the girder bars an opportunity to pass by. Or, in high buildings, they may be used for outside columns where great stiffness is required in one direction.

CONCLUSIONS AND OTHER TESTS

From the fact that the maximum loads of all columns were the same when the spiral reinforcement was near the breaking point, we may infer that higher ultimate values for the strength of these columns would have been obtained if a larger percentage of spiral reinforcement had been used. This conclusion is justified also by tests made by Dr. Emperger since 1911.

Tests made by the Austrian Concrete Institute, using 1:2:4 concrete, reported in Volumn 3 of the *Proceedings*, 1911, included two columns with a core diameter of 9.6 in., a length of 10 ft. and spiral reinforcement slightly exceeding 3 per cent. They failed at an average concrete unit stress of 7500 lb. per square inch and an average unit stress in the cast iron of about 60,000 lb. This cast iron was of ordinary grade. In all other tests Dr. Emperger used high-grade cast iron with an ultimate strength of 110,000 to 120,000 lb. per square inch. Combined with high percentage of hooping, this cast-iron reinforcement resulted in uniform strengths such as could be obtained only with a solid-steel section. For example, one column had a concrete area inside the core of 9.86 sq. in., a cast-iron area of 3.12 sq. in., or a total of 12.98 sq. in., and failed at a total load of 392,000 lb., equivalent to about 30,000 lb. per square inch of the area in compression. This should be compared with the 8000 to 10,000 lb. per square inch of area of an inclosed rectangle for structural-steel columns made up of angles and plates.

Seven tests were made for the city of Dresden in 1916, using four angle-shaped cast-iron sections with tie plates, ties and hooping, limited to 0.69 per cent, as they represented to small scale the arch ribs for a span of 460 ft. Although tests of plain concrete cubes averaged less than 2000 lb. unit stress, the columns failed at an average stress of 12,000 lb. per square inch of core area.

Mr. Mensch finally concludes that in the hooped concrete column reinforced with cast iron there is obtained a compression member which can sustain stresses up to 17,000 lb. per square inch, hence allowing smaller sizes than columns built of structural steel at a very great saving in cost.

Cubic Cost of Washington Buildings

The cost of district and school buildings for the District of Columbia, which have ranged between 14 and 17 cents per cubic foot, will probably cost from 18 to 20 cents within the next year, according to the 1916 report of the Engineer Department. Last year three school buildings cost approximately 14½ cents, while an engine and truck house averaged 19 cents. It is further stated that the buildings and repairs cost less in Washington than in any other city with the exception of Cleveland.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

State Highway Department for Wyoming

SIR: In your issue of Feb. 10, page 235, I notice a statement that Wyoming is prohibited by its constitution from participating in works of internal improvement. This was true until recently, but our constitution has been amended to eliminate this clause.

It might be of interest to add that the legislature has just passed an act creating a state highway department and providing funds for the construction of state highways. The bill which passed was drawn and indorsed by the Wyoming Good Roads Association, of which G. E. Parisoe of Laramie is president.

This act creates a state highway commission of five appointed by the Governor. The commission is to select a state highway engineer, who is to be the executive head of the department and have complete supervision over the construction and maintenance of highways and bridges.

Z. E. SEVISON,
Laramie, Wyo. Civil and Irrigation Engineer.

Quartz Gravel or Defective Design?

SIR: Referring to the report of Ira H. Woolson on the effect of fire on the reinforced-concrete warehouse at Far Rockaway, N. Y., abstracted in the Engineering Record of Jan. 20, page 98, in which he places the blame of the failure on the use of quartz gravel, I would like to call attention to a still more serious and sinister feature of this structure, and one that can be controlled by the builder or engineer with greater facility than the selection of stone not affected by heat.

This building is another exemplification of failure due to bad standards of design, another of a long and growing list of failures that cry out against the use of the rodded column. The column shown on page 98 failed because it was a rodded column. This is something that can be positively demonstrated. If this column had been reinforced with closely spaced circular hooping and upright rods, it could not possibly have failed as it did under the load it sustained. The proof of this is found in the record of numerous tests on hooped columns that could be cited. Many of these have stood test loads of several thousand pounds per square inch even after bowing out of line several inches. It is impossible that the concrete within the hooping could be in any other state than one of disintegration—worse than that of the concrete in the heart of the column in the Far Rockaway warehouse. A properly designed hooped column could therefore not have failed, for it would not be subject to several thousand pounds per square inch of load. Hooping, furthermore, would retard or prevent cracking of the core. Every large rodded-column structure is subject to menace in case of fire, or possibly in the absence of fire.

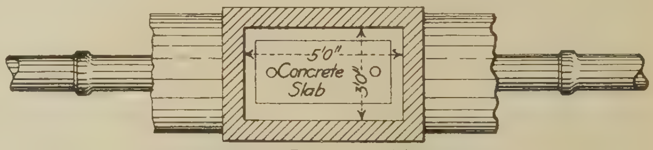
Another feature of bad standards of design is shown in the failure of the floor girders. This is the absence of bent-up and anchored shear or diagonal tension reinforcement in the part of the fourth floor that failed. There were "shear members," so called, but bent-up and anchored steel was lacking; hence the failure. Every structure lacking bent-up and anchored steel in the beams is subject to this second menace in the case of fire, or possibly in the absence of fire.

Pittsburgh. EDWARD GODFREY.

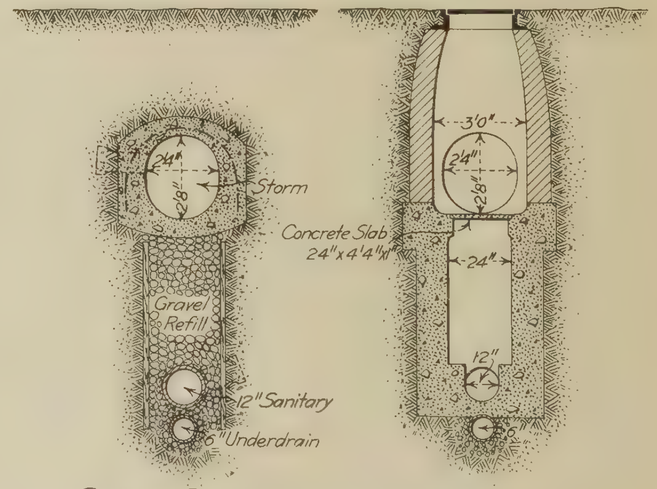
Two Sewers Laid in One Trench

SIR: I was interested in reading the article in your issue of Jan. 27, page 138, about the two sewers laid in one trench. We have been constructing two sewers in one trench in Cambridge since 1889, ranging in a great variety of shapes and sizes from a storm sewer 5 ft. 8 in. by 6 ft. over an 8-in. sanitary sewer to a 24-in. storm sewer over a 24 x 26-in. sanitary sewer.

The method of constructing the manhole is quite different from that described. No deflection in the alignment of the upper sewer is made, as the manhole is built to keep the flow separate and yet to give access to both sewers by constructing a removable bottom or floor slab in the upper chamber. In order to inspect and clean the lower sewer, it is necessary only to tilt up the floor slab by means of the two-ring bolts. This would usually be done when nothing was running in the storm sewer.



SECTIONAL PLAN OF MANHOLE



CROSS-SECTION THROUGH SEWER   CROSS-SECTION THROUGH MANHOLE

NO DEFLECTION IN ALIGNMENT AT MANHOLES

The drawing shows a rather interesting example of this type of construction on account of the unusual distance between the two sewers. Ordinarily, they are only about 2 ft. or less apart, thus reducing the depth of the lower chamber and increasing the accessibility of the lower sewer.

This style of "two-story" manholes has given excellent satisfaction, being convenient as well as inexpensive.

L. M. HASTINGS,
City Engineer.
Cambridge, Mass.

SIR: I note in your issue of Jan. 27, page 138, Manley Osgood's design for two sewers laid in one trench. This is an expedient adopted by the writer in the plans for the sewerage system of New Hartford, N. Y., in 1896, the only essential difference being that the stormwater sewer was placed below the grade of the sanitary sewer, and with porous joints, to lower the ground water, thus enabling easier construction of the sanitary sewer and greater security against leakage, for the joints were made with jute and cement. For good foundation the sanitary sewer was laid on a shelf or shoulder cut in the side of the trench made for the lower sewer after that was laid and covered. The invert of the sanitary sewer was at the same elevation as the top of the other. Both have been continuously in operation and without trouble of any kind.

A. M. SCRIPTURE,
Consulting Engineer.
New Hartford, N. Y.

What Are They Doing About It?

SIR: In your issue of Jan. 20, page 115, under the caption, "What Are They Doing About It?" is a letter from Prof. F. H. Newell on the subject of Professor Baker's report on the pavements of Chicago (see Engineering Record of Dec. 30, 1916, page 790).

In answer to Professor Newell I will say that the Western Society of Engineers and the Illinois Society of Engineers will be asked to investigate the statements and conclusions contained in Professor Baker's report, with a view to determining the accuracy of the report, especially those statements and conclusions that have led the people of Chicago to believe that the property owners have been robbed of $400,000 annually by the paving contractors of Chicago.

Unless these societies and others have sufficient interest in the honor of the societies and the honor of their members to make such investigations and to expel from membership any engineer who is guilty of permitting such wholesale robbery as is alleged, or expel from membership any engineer who would make such wholesale accusations against engineers, when such accusations are unfounded, then I fail to see of what benefit such societies can be to engineers who are self-respecting.

Before the issuance of this report I would have agreed with Professor Newell that no question can be raised as to Professor Baker's ability and fairness. Since reading this report I am convinced that the conclusions in it relating to this robbery of property owners is entirely unfounded by the statements in the report and that at least some of the statements, upon which these conclusions are based, are quite incorrect, and in at least one instance Professor Baker had definite data which contradicted his statement in the report. I refer specifically to his statement on page 12, where he says:

"The shortage in each of the three cases, respectively, is: 21 per cent, 12 per cent and 21 per cent, or an average of 18 per cent, regardless of the relative areas or of the relative number of observations. The above are all the definite data I have or can find on the thickness of the concrete base. If it be assumed that these data are representative, the possible loss to the property holders by skimping may be computed as follows: In 1915 the board laid 1,498,000 sq. yd. of pavements having a concrete base. The materials of the base cost about 60 cents per sq. yd. Hence the loss was $0.18 \times 1{,}498{,}000 \times 60$ cents = $161,784."

The investigators of the finance committee furnished to Professor Baker more than 100 reports covering various features of the work. Among these were a number relating to the thickness of concrete. Twenty-nine of these reports show that work of laying concrete foundation was in progress at the time of inspection of the investigator, besides five other cases where the thickness of the concrete was indicated on the reports. Nineteen of the reports make no mention of thickness of concrete; four of them show the thickness to be 6 in.; four of them are marked "O. K."; four of them show the thickness to be between 5 and 6 in.; three of them contain the "definite data" referred to by Professor Baker.

Professor Baker then assumes that all of the work done by the Board of Local Improvements is of the same character as that disclosed in the three cases, which are the worst disclosed by all of these reports.

In the portions of the report relating to asphalt pavements there are similar misstatements and unfair conclusions.

C. D. HILL,
Engineer, Board of Local Improvements.
Chicago.

[Professor Newell's comment on Mr. Hill's letter follows.]

SIR: I have read C. D. Hill's letter and regret to see that he is so deeply stirred and that he unduly emphasizes the question of "honor." In my opinion we should carefully distinguish between efficiency and honor in such matters. The efficiency of an organization may be controlled by conditions entirely outside of the honor or integrity of the men in responsible charge. Often they are so involved in other matters that they cannot get out into the field or reach down into their organizations and really know what is taking place. Under such conditions they should welcome any suggestion which, though unpalatable, may, in the end, lead to improved conditions.

I may have as a friend and neighbor a man of the highest personal integrity, and yet I may not find that in business dealings he is "delivering the goods." There are an infinite number of reasons why this may be the case, none of which reflects upon his honor but is the outgrowth of the environment.

In the present case an inspection was made in good faith, the results reported and the statement clearly made that if it is assumed that these data are representative, then certain possible losses have occurred. This should not be considered as a question of honor, but should be calmly and seriously considered with a view to endeavoring to rectify conditions if they are as indicated by the observations made.

Because of the strong personal attitude taken in the matter, it seems to me that it is unwise to continue along the present lines, but rather try to ascertain the physical facts.

F. H. NEWELL,
Professor of Civil Engineering, University of Illinois.
Urbana, Ill.

Patented Pavements and Standard Specifications

SIR: I beg to thank you for publication in your issue of Jan. 20, page 114, of my communication sent you recently, together with your editorial footnote comments thereon. I am not sending you this acknowledgment with either request or intention that you publish it, but you may feel free to do so if you so desire.

It is true that the illustrations accompanying my paper on "The Passing and Conservation of Macadam City Streets and Country Roads" did contain photographs of Bitulithic and Warrenite, and were so labeled. It is also true that a "cut-in" on the film of the Columbia River Highway did refer to this construction as Warrenite road. It is also incidentally true that that "cut-in" was exactly as we had received the film from the Shriners, who had taken it for specific use at the Shriners' Buffalo Conclave and loaned it to us for specific use at the Newark convention of the American Society of Municipal Improvements. I do not think that this use of the name of the kind of construction used can at all be attributed to commercialism. If, for instance, the road had happened to be concrete, brick or asphalt, you surely would not have considered the subject properly presented if they had simply said "a road," or "a street" or "a pavement," and would not have considered the fact that someone is interested in selling brick, Portland cement or asphalt as any reason for not giving the road or pavement construction its proper commercial name.

Apply the same rule to your business. You certainly get a certain amount of commercial advantage every time that the Engineering Record is referred to in technical association meetings or otherwise, and you would not consider that a reference to some such designation as "an engineering paper with a red cover" would be suitable or proper, or give the persons addressed a correct idea of what it meant.

In other words, Mr. Editor, your trouble is that you apparently feel that a patent, however valuable, is a thing which should be ignored in public mention, and you seem to regard the word "standard" as not including anything that is patented, whereas it seems to me very clear that extent and success of use are the things which determine standardization. If patented constructions of merit are to be ignored by engineering societies or engineering periodicals, then it means that those societies, periodicals, and the public, to the extent the public is influenced by them, are seventeen years behind the times, for it is fair to assume that everything novel and destined to be at all generally useful will be patented. Surely if an article is meritorious its use should not be ignored or discouraged simply because the article is patented, especially in view of the fact that the United States Constitution, patent laws and decisions of the United States Supreme Court take a directly opposite view.

The following extracts from Walker on "Patents" is illustrative of the point:

"In the United States of America, the superior right of an inventor to his invention has a far better foundation than could be furnished by the prerogative of any kind. That foundation is the consent of the people of the United States: a consent primarily expressed in the federal Constitution, and elaborately defined in the federal statutes."

"The right of property which an inventor has in his invention is excelled, in point of dignity, by no other property right whatever. It is equaled, in point of dignity, by the rights which authors have in their copyrighted books. The inventor is not the pampered favorite or beneficiary of the government or of the nation. The benefits which he confers are greater than those which he receives. . . . He receives nothing but a contract, which provides that, for a limited time, he may exclusively enjoy his own."

Many extracts of similar force, directly from Supreme Court decisions, could be easily given, but it seems to be quite unnecessary, as the propriety of patents as an economic policy is an established part of practically every progressive government in the world.

I quite agree with you that it is incompatible with the dignity and principles of a technical society to show "commercial partisanship," but I beg to reiterate that proper mention of a patented construction by technical publications, or the inclusion of standard patented constructions among the standard specifications of a technical society, is not in any sense "commercial partisanship."

On the contrary, I believe that to refrain from including the standard as such because it is patented would be a serious omission from what the public has a right to expect from such periodicals and societies.

You say: "If Bitulithic can have a specification, why not every other patented paving that has proved its worth?" My answer is, there is no reason why any patented paving or any other patented article in municipal construction should not be referred to and standardized by a standard association, provided it has "proved its worth."

In my previous communication I said: "In fact, I think 'standard' specifications should include every form of construction which has had a long or broad enough practical use to prove its 'efficiency and economy,' whether the desideratum be from either the points of view of high grade and correspondingly higher cost, or of lower cost and, although inferior, economically useful at the price." My point is that no article is either more or less standard because it is or is not patented.

As to the American Society of Municipal Improvements, I hope that I will always be found, as I believe I have been during the past 20 years, in the position of broadly and not narrowly doing what I can to assist the society along proper lines. The society in convention has consistently refused to do the things which you condemn, and your criticisms do not apply to the body as a whole. I believe that whatever criticism is justly due should be placed at the door of not exceeding half a dozen of its active members, who because of either lack of attention or lack of time, if not intention to mislead the society, have withheld their reports until the last hour, instead of making them a sufficient time before convention so that they can be presented to all the members for their consideration in advance of, and intelligent action taken at, the conventions.

I may be incorrectly informed, but I understand that prior to the Newark convention a rule was adopted by the executive committee for future procedure to the effect that no report will be considered at a convention which has not been given such advance publication to the members of the society. This should do much to protect convention sessions from objectionable movements arising either within or without its active membership.

George C. Warren,
President, Warren Brothers Company.
Boston.

Camera on Engineering Work

Sir: I was very much interested in the long article on the use of the camera in engineering work by H. Colin Campbell, which appeared in the Engineering Record of Dec. 2, page 670, and the discussions of the same subject by Messrs. Johnson, Smith and Bintz that were printed in the Dec. 16 and Jan. 27 issues. I am glad you have devoted so much space to this very important subject. I regret, however, that none of the above-named contributors had anything to say about the Autographic camera, which enables one to impress on the film directly at the time of making the exposure the what, the when and the where. It is as handy a camera, especially suited for taking pictures of engineering work, as there is on the market.

WITH THE AUTOGRAPHIC CAMERA EACH FILM MAY BE PERMANENTLY LABELED, AS SHOWN

The Autographic camera is equipped with a spring door in the back, which is closed by a stop. This little door covers a slot through which one may write, with a hard pencil or stylus provided for the purpose, any information he desires on the red paper protecting the film. Between the red paper and the film is a thin strip of black displacing tissue which serves the double purpose of light-proofing the cartridge and permitting the recording on the film, by light, of the writing on the red paper. When the data have been recorded and printed (by exposing with the door open to the sky, but not the sun, for a second or two) the record is photographically impressed on the film, and appears when the film is developed. The slot is so located as to bring the title into the margin between the exposures when the film number appears centered in the little red window in the back of the camera. This brings the title at the bottom of an upright, or at the left of a horizontal, negative. Autographic film may be obtained from any photographic dealer.

The advantage of the autographic feature is that every picture can be given a date and a title. By using a code a surprising amount of information may be recorded to supplement that shown in the photograph. If desired, the writing can be impressed on the end of the negative so that it will be included in the picture, as shown in one of the accompanying illustrations, or the entire adjoining film can be used for the purpose.

For making serial records showing the progress of construction work, the autographic feature is particularly useful. The information written at the end of the negative identifies it for all time. By having negatives signed by inspectors, contractors or other responsible persons, controversies can often be obviated. Such a record may also prove an insurance against litigation.

Everyone of your correspondents mentioned above emphasizes the importance of filing negatives properly. The written record on the end of the negative facilitates all filing operations. Mr. Campbell also asserted that a proper record should be made of all attendant facts associated with a picture, especially the time and place of taking and by whom made. If this record is placed on the film instead of in a notebook, which may be lost or misplaced or easily become separated from the negatives, it serves its purpose much more advantageously. All in all, I think the Autographic camera should be in the hands of every up-to-date engineer.

E. A. Hunger,
Rochester, N. Y. Eastman Kodak Company.

Unauthorized Use of Photographs

Sir: I notice with displeasure that photographs illustrating my article on the effect of water, the chief factor in the making of concrete, in your issue of Dec. 30, 1916, page 790, had been used to illustrate an advertisement for a commercial product. These photographs have been used without my permission, nor was even the courtesy of a request for them accorded me. Their use in such connection is particularly regretted.

Nathan C. Johnson,
New York City. Consulting Concrete Engineer.

Damages for Sewage Pollution

Suit was brought against the city of Princeton, Ky., for damages caused by the pollution of a creek by the city sewage. The court was also asked to issue an injunction prohibiting the city from discharging sewage into the creek. The circuit court granted the injunction and awarded $2,500 damages against the city. The Court of Appeals of Kentucky affirmed the judgment for damages, but the injunction was dismissed, as the court found from the evidence that it was possible to discharge the sewage into the stream in such a way as not seriously to injure owners of property below the sewer outlet.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Boiling Hot Caustic Soda and Cement Mixture Stop Leaks in Concrete

By H. W. STREULI
Schenectady, N. Y.

LEAKS IN CONCRETE can be stopped in the face of running water, even when this is under some pressure, by enlarging the break and properly applying a hot mixture of cement and caustic soda, which sets almost instantly.

Leaks of this kind frequently occur even in the most careful work. Sometimes they result from small defects in the joints between one day's concreting and the next, where a small area has not been perfectly cleaned, or where a low spot in the old concrete retains water used to wash the surface and forms a "honeycomb." Leaks are sometimes produced through no fault of the contractor where the concrete has been placed under extreme temperature conditions without sufficient provision in the way of expansion joints. Slight unequal settlement or shrinkage may also produce leaks.

When leaks develop it is generally too late in any case to remedy the cause, and the only thing left to do is to stop them, sometimes at the expense of considerable money to the contractor and worry to the engineer.

This is often done by piping the flow to one point, grouting in the pipe while it is passing the water, cutting the pipe off within the surface of the concrete and capping it, after which the hole left over the pipe is plastered up. This is a slow, expensive and puttering way of doing the job. Frequently the pipe rusts, discoloring the concrete and sometimes reopening the leak. There is always danger of this if the pipe is exposed to electrolytic action. Leaks may also be calked before plastering with jute, or with lead wool and wood wedges. Jute will only do for small leaks without much pressure, and many engineers do not approve of the use of wood left permanently in the concrete.

To overcome these objections, the method referred to was developed by the writer in connection with other construction superintendents and engineers on sections of the Catskill Aqueduct and Passaic Valley sewer, where leaks which occurred months after the completion of portions of the work caused considerable trouble. The section of concrete around the leak is cut out to a depth of 3 or 4 in. with a chisel so that the hole is larger at the base than at the surface. A small quantity of fresh Portland cement is then mixed with a boiling-hot solution of caustic soda into a thick paste, which is applied rapidly with the hands (which should be covered with rubber gloves) to one side of the cavity. The plaster is pressed firmly against the old concrete and held for a minute or more. In this length of time it sets very hard and can only be removed with a chisel. This operation is repeated, following around the sides of the cavity, until a small opening remains, through which the water is now flowing. This small opening is again shaped with a chisel till the bottom is larger than the opening at the surface. Enough freshly mixed paste is then taken in the hand completely to fill this opening, and applied suddenly with one hand, holding the paste in place for a few minutes. If the work has been done well, the leak will be completely closed.

Of course, practice is required for the successful use of this method, and there are several important points to be carefully observed. The soda must be of the best quality and fresh, very concentrated and mixed with very little water. The mixture must be boiling hot when the cement is added, and the latter must also be perfectly fresh. Very little of the paste should be prepared at one time, as it hardens almost instantly. Just enough of the soda solution should be used to make a stiff paste, which should be mixed very rapidly by kneading it with the hands. The rubber gloves are essential, and anyone attempting to handle the paste without them will certainly regret it.

How About It?

YOU SELL or rent your plant when you finish the job it was bought for and it doesn't fit in on your other work— Don't you?

YOU LEND a man now and then when you don't need him and another firm wants him badly— Don't you?

YOU GET AMPLE RETURNS from both these little practices when the other fellow reciprocates— Don't you?

TRY PASSING ON a few of your bright ideas—that you might not use again in ten years and that may save money for the other man to-morrow— Won't you?

WHEN THE OTHER FELLOW comes back and tells you what he got up, you can use it— Can't you?

YES—and there are hundreds of the "other fellow" to one of you!

NO DOUBT OF IT, you'll profit if you keep the ball rolling and send in your contributions to

HINTS FOR THE CONTRACTOR

"Rounding Up the Junk"

IN a Western state a county which has extensive road work under way has established the policy of sending a motor truck from job to job once a month collecting equipment which has been laid aside because of damage or completion of the work on which it was useful. This is called the "monthly roundup of junk"; but it has been found that a very large percentage, perhaps ninetenths, of this "junk" proves most useful after being put in repair. It is stored in the proper place and listed by the man whose function is to dispatch equipment.

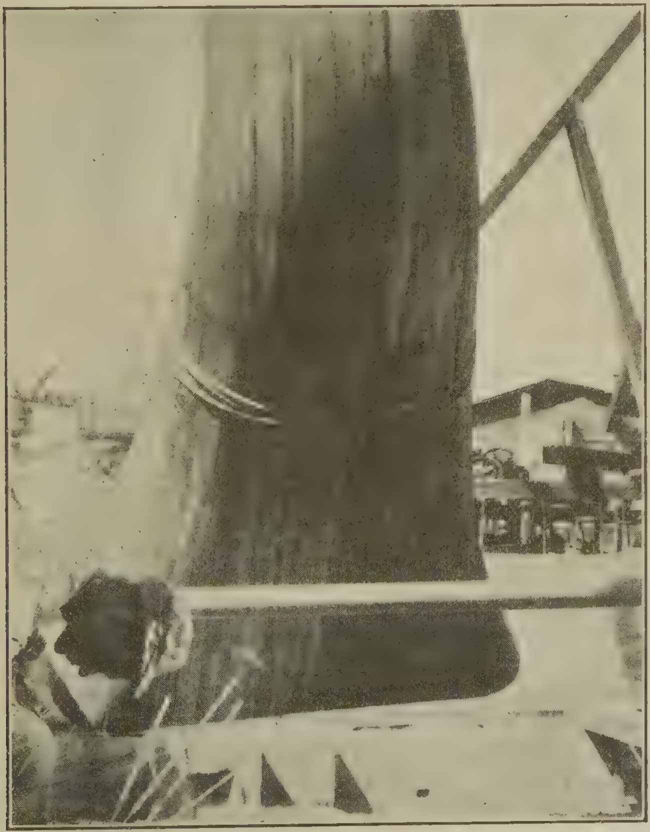
In the rush of construction work it is often better to set aside certain equipment when something else can be substituted with a saving in cost or time. This practice of substitution is a phase of progressiveness and is certainly good policy when properly applied. It cannot be considered good policy, however, to allow equipment to be neglected or abandoned simply because the exigencies crowd it out of service on a particular job. Such loss can be avoided with a system whereby someone connected with the organization and who makes regular trips over the work is assigned to keep a watchful eye open for "junk." Discarded equipment which he finds can be easily noted down, with a memo of the location, and at suitable intervals a motor truck going over the work can call at the specified points and collect the various items listed.

An example of the success of such a scheme was recently afforded in the county referred to when a small pile driver wanted in a hurry was built up entirely from equipment collected in this way.

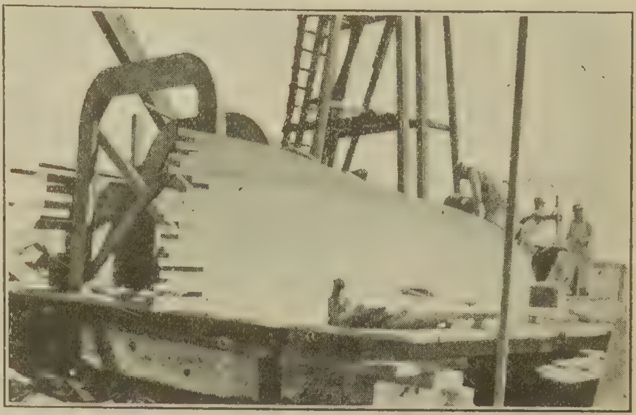
Large Intake Forms Easily Laid Out When Built in Halves

By C. H. TORNQUIST
Paris, Idaho

BY DIVIDING the form in halves by a vertical plane and building each half with its open side down, the work of laying out and constructing large draft tube or intake tube forms is greatly facilitated. This method, shown in the photographs, was employed in building the intake-tube forms for the Lifton pumping station of the Utah Power & Light Company at Bear Lake, Idaho, the construction of which was described in the Engineering Record of July 22, 1916, page 98.



FORMS SUPPORTED IN PLACE ONLY AT ENDS



HALF FORMS EASILY LAID OUT AND BUILT

The writer has built draft-tube forms as whole units in an upright position upon saddles and found the method very expensive in addition to the difficulty of doing accurate work. By constructing the forms in halves on a platform, however, it is a much simpler matter to lay them out, and also easier to build them, as all parts of the form are readily accessible. The forms were trussed along the vertical plane to counteract the tendency of the lagging to straighten and also to retain the shape of the form when handled by a derrick. The forms were held in position for concreting by supporting the lower end of each form while the upper end was swung from a chain block, the truss work being strong enough to carry the weight. On account of its curved surfaces, this form would seem very difficult to build, but with the method outlined the construction was comparatively simple.

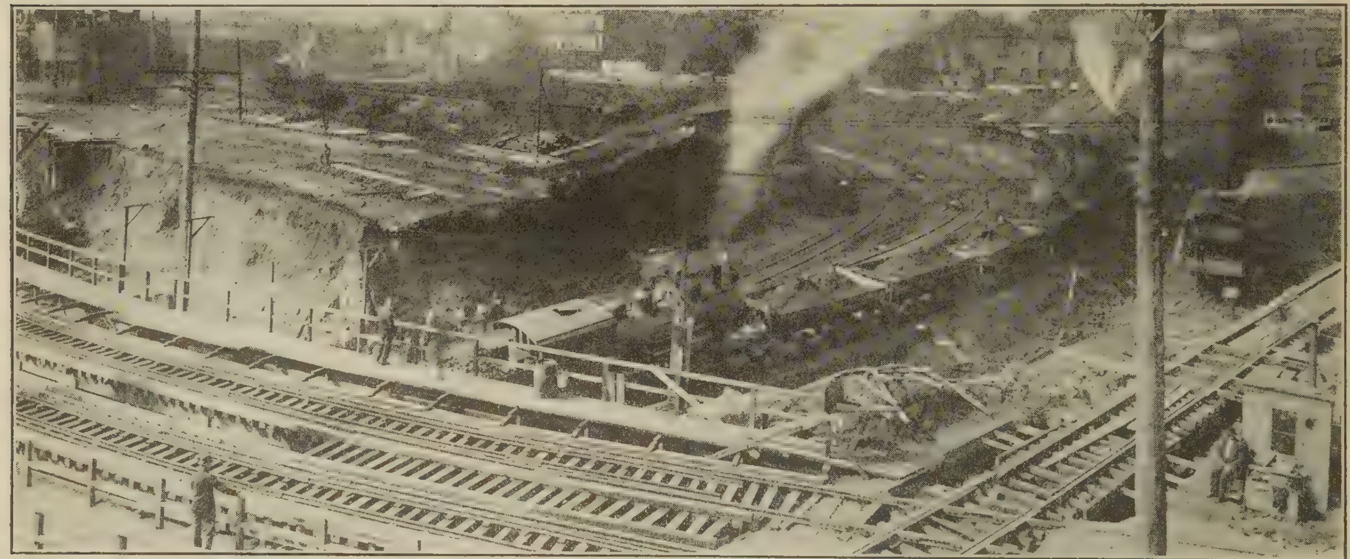
The work on which these forms were used was carried out by the Jarrett-Chambers Company, Inc.

Excavate Mammoth Basement by Railroad Methods

THE REMOVAL of 250,000 cu. yd. of excavation from two city blocks in St. Louis, in which the element of time was an important factor, has recently been accomplished by the use of standard railroad methods. On the site, 254 x 720 ft., at Broadway and Fifth Avenue, is to be located the Bevo plant of the Anheuser-Busch Brewing Company. Following bids for the work, all of which ranged from 85 cents per yard up, a subsidiary of the company took over the work and has completed it at a cost of 41 cents per yard. One of the bidders proposed to put 1000 teams on the job, but the work has been accomplished by steam shovels and standard-gage trains hauling the material a mile away to a dump at the river and Cherokee Street.

As the earth under Broadway was to be removed also to make way for a concrete viaduct, the first operation was to build a temporary wooden trestle, 500 ft. long, over property of the company 50 ft. to the south, to carry the street cars. After the removal of a series of buildings alongside Broadway built in an area formerly excavated down to grade, operations were begun with one of the two 90-ton steam shovels at the northeast.

corner of the area, extending a shallow 12-ft. cut for a loading track west across the lot and turning to the south along the west side. As soon as this cut was completed the machine was brought back, cars put on the upper tracks and a 32-ft. cut to grade made alongside the loading track. Before this second cut was completed, the second shovel of the same capacity was started on the other side, both shovels working at the same time loading to different trains so that both trains could be pulled out at the same time and not interfere with each other. As soon as the second cut was made a track was placed in it and a third and succeeding cuts started again at the northeast corner. At the height of the work 7000 yd. was removed daily with one 90-ton Bucyrus shovel with a 3-yd. bucket, one Marion with similar capacity, a smaller Bucyrus with a 1½-yd. bucket, and a Thew with a ¾-yd. bucket. Each of the larger machines removed about 3000 yd. daily. An Orton & Steinbrenner locomotive crane with a 1-yd. clamshell excavated trenches for the 4 ft. concrete retaining wall, which is to encircle the whole area, piling the earth and material from the corners where they could be reached by the large machines. A Lidgerwood hoist operating a derrick with a skip from a 35-ft. boom is also used in the excavation of the trenches. About 125 men were employed in this excavation work.



RAILROAD SHOVELS EXCAVATE BASEMENT IN HEART OF CITY

Temporary trestle in foreground 50 ft. from and parallel to Broadway. Train is on loading track placed first in shallow cut. Single service track for brewery at end of temporary trestle at street grade maintained throughout work.

Material was hauled from the site in 100 12-yd. steel Western and Oliver side-dump cars by four standard-gage Baldwin locomotives, 1 mile to the river bank, where a switch track was provided paralleling the shore and the main-line track. No trestle was built, but the track was raised by a force of forty men to the elevation of adjoining land, a Jordan spreader being used during this period. Further dumping was done from the edge of the embankment encroaching on the river. This is to be protected by a concrete revetment.

A concrete wall along Broadway, 20 ft. high and 2 ft. wide, was removed by one of the derricks after breaking up with dynamite. Holes were drilled in the center of the top 5 ft. apart and shot one at a time so as not to damage the temporary trestle. Rock in the excavation occurring at varying elevations was loosened up after drilling with twelve Sullivan pneumatic drills operated day and night. From one to fifteen holes, drilled 6 to 8 in. below the required grade, were shot simultaneously with 60 to 80 per cent giant powder.

The excavation was started the latter part of September and finished the middle of February. The Gilsonite Construction Company is doing the work. R. P. Dalton is in charge of the excavation for that company and L. L. Peck is superintendent of construction. F. C. Taxis and W. J. Knight & Company are the associated engineers.

Tie Placed Ahead of Rear Truck Levels Cinders Dumped from Hopper Car

By GEORGE A. GIORLOFF
New York City

IN MAKING a cinder fill at the plant of the White Tar Company under construction at Kearny, N. J., the material was spread outside the track by placing a tie across the rails in front of the rear truck of the hopper-bottom car, which was kept in motion while being dumped. The cars were first dumped without using the tie, but the cinders ran out so fast as to block the track and require numerous stops and a great deal of hand shoveling before unloading could proceed. The use of the crosstie overcame this difficulty, the tie tilting up slightly and sliding along the rails, pushing the cinders out at the sides and keeping the rails and the center of the track clear. With the hopper doors wide open the cinders ran out just fast enough to pile up so that a small quantity would spill over the top of the tie. This quantity, however, was not sufficient to block the track, and all the cars unloaded by this method were completely emptied in a few minutes without any stops for shoveling. The tie stood high enough above the rail so that there was no tendency for the truck to ride over it and ditch the car. The contract on which this fill was made is being carried out by T. L. MacBean.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Engineers Qualify as Reserve Officers, U. S. Army

War Department Announces Names of Ninety-One Men Who Have Accepted Army Commissions

Ninety-one engineers have accepted commissions in the Engineer Officers' Reserve Corps, created by the National Defense Act of June 3, 1916, according to an announcement from the office of Brig.-Gen. W. M. Black, chief of engineers, dated Feb. 15. Boards of officers located in the important cities throughout the country are still busily engaged in the examination of applicants, and to date 1200 applications have been received. New applications are reaching the War Department at the rate of almost 200 per month. Blanks to be filled in by those seeking examination may be obtained by writing to the Chief of Engineers, War Department, Washington, D. C.

Newly Appointed Officers

The following is the list of men who had accepted commissions as reserve officers up to Feb. 15:

Majors—William Barclay Parsons, N. Y.; John S. Sewell, Ala.; H. A. Gillis, Wash., D. C.; Ralph D. Mershon, N. Y.; Arthur S. Dwight, N. Y.; Bion Joseph Arnold, Ill.; Frank Sutton, Wash., D. C.; James C. McGuire, N. Y.; Glenn S. Smith, Wash., D. C.; John H. Finney, Wash., D. C.; Arthur M. Waitt, N. Y.; Conway B. Hunt, Wash., D. C.; Frank G. Jonah, Mo.; William F. Dennis, Wash., D. C.; Gardner S. Williams, Mich.; John C. Ostrup, N. Y.; John H. Poole, Mich.; Evarts Tracy, N. Y.; Eugene W. Stern, N. Y.; Frederic A. Molitor, N. Y.

Captains—Howard H. Maxfield, Pa.; Arthur A. Reimer, N. J.; Thomas B. Whitted, N. C.; Leon E. Lyon, Va.; Walter C. Allen, Wash., D. C.; Thomas C. Clarke, N. Y.; William M. Lamson, N. Y.; Charles DePuy Robison, N. Y.; Edwin R. Quinby, N. Y.; Chandler Davis, N. Y.; Robert W. Chaffee, Conn.; James L. Taylor, Jr., Pa.; Lawrence E. Curdman, Kan.; John T. Talman, Wash., D. C.; George H. Gifford, N. Y.; Frazer C. Hilder, Va.; Morris F. La Croix, Mass.; George F. Hobson, Md.; Lynn C. Boyatt, Ohio; Isaac S. Matlaw, N. Y.; John P. Hogan, N. Y.; Harry Baker, N. J.; Irving P. Kane, Md.

First Lieutenants—Clifton W. Wilder, N. Y.; Joseph M. Marshall, Jr., N. Y.; Walter H. Meier, Okla.; William Burton, N. J.; Samuel H. Sherrard, N. J.; Diedrich W. Krellwitz, N. Y.; William Hague, Cal.; Arthur C. Forbes, N. Y.; Maurice R. Scharff, Pa.; Clifford L. Harrod, Pa.; Edward B. Snell, N. Y.;

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To Subscribers for the Engineering Record

Subscriptions for the Engineering Record will be continued automatically as subscriptions for the Engineering News-Record after the consolidation with the Engineering News takes place April 5. Where both papers have been subscribed for, the unexpired terms of the two subscriptions will be added together and applied on the Engineering News-Record. In other words, readers will get for the unexpired terms of their subscriptions the greatly increased value that will result from the consolidation of the two papers.

Tentative Plans for New Freight Terminal in San Francisco

Tentative plans have been announced by the Southern Pacific Railroad for the channel and waterfront improvement in China Basin at San Francisco. The railroad recently acquired this property through an exchange of real estate with the city.

The channel is at present 140 ft. wide. The plan is to widen it to 300 ft., with a minimum depth of 35 ft., and to build large warehouses on the north side where the company now has the terminal of the coast rail lines. In the ultimate development the terminal will cost about $10,000,000, according to an estimate made by the company's engineers.

Improvements Required

A new single-lift bascule bridge would be required across the channel at Third Street, the clear opening of which would be 120 ft. Lift bridges would also be required at Fourth and Sixth streets. About 7500 lin. ft. of bulkhead would be necessary around the edge of the dredged area.

The warehouses, according to the tentative plans, would be 800 ft. long and six to eight stories high. The main floor, arranged for the convenient transfer of freight, would have a depressed truckway for teams and adequate trackage, while upper stories of the buildings would be leased for warehouse purposes. The original plans for the development were drawn up by Howard C. Holmes, consulting engineer, of San Francisco.

McGraw and Hill Publishing Companies Consolidate

Eleven Leading Technical Papers Brought Under One Administration—Engineering Record and Engineering News to Consolidate

The McGraw Publishing Company Inc. and the Hill Publishing Company have been consolidated as the McGraw-Hill Publishing Company, Inc. The new company acquires all the properties and interests of the two constituents, including the following technical journals:

Engineering Record, Electrical World, Electric Railway Journal, Electrical Merchandising, Metallurgical and Chemical Engineering, The Contractor, American Machinist, Power, Engineering News, Engineering and Mining Journal, and Coal Age.

Two of these papers, Engineering News and Engineering Record, will be consolidated under the name Engineering News-Record. E. J. Mehren, editor of the Engineering Record, will become vice-president and general manager of the McGraw-Hill Publishing Company. Charles Whiting Baker, now editor of Engineering News, will act as editor-in-chief of the Engineering News-Record.

James H. McGraw will be president of the new company and Arthur J. Baldwin, now president of the Hill Publishing Company, vice-president and treasurer.

Propose Municipal Engineering Short Course

An annual short course in Municipal Engineering at the University of Texas at Austin, to be conducted under the auspices of the Engineering Department, was proposed at a recent meeting of cty engineers of the state, at Austin. The proposition met with approval and will probably be put into effect.

Growth of Testing Materials Society Continues

Notwithstanding the increase of 50 per cent in dues which became effective on Jan. 1, 1916, the growth in membership of the American Society for Testing Materials has been well maintained, the net increase for 1916 being 171 as compared with 208 for the previous year. The present total membership is 2132, which represents a net increase of 62 in comparison with the figures reported at the last annual meeting in June. There is every indication that the increase in dues will result in only a slight and temporary impairment in the growth rate of membership.

Wisconsin Society Shows Healthy Growth

In 1915 a handful of Wisconsin engineers voted on the question of disbanding the state organization, but at the last convention, held at Madison, Feb. 15 and 16, there was an attendance of more than fifty engineers. The membership has increased to 166, and the treasurer reported a surplus of $508.50. The diversity of the membership, segregated by the secretary, Prof. L. S. Smith, is as follows: Highway engineers and commissioners, 13; city engineers, 27; consulting engineers, 24; miscellaneous civil engineers, 16; architects, 5; mechanical and electrical engineers, 12; contractors, 17; salesmen, 32; miscellaneous, 20.

For the benefit of contractors, standardized plans and profiles for municipal work were suggested in the annual address of J. S. McCullough, city engineer of Fond du Lac and president of the society. The legislation committee recommended that all surveyors be placed on the same footing with the county surveyors, who are now required to file plats and complete data of land surveys at the county courthouse. At present land surveys are not recorded unless the work is done by the county surveyor. Methods used in evaluating the Chicago Elevated were outlined by F. J. Bachelder, consulting engineer, Chicago, who has just finished the work for the Subway and Traction Commission.

Esthetic considerations in bridge design by Prof. W. S. Kinne elicited one of the most spirited discussions. Some of the suggestions were: Make structures conform to the surroundings; design end spans of a bridge, if materially smaller than the main spans, of a different type, so that they will not appear like "samples" of the real spans; eliminate a pier at the center of bridge by choosing an odd number of spans; separate different types of spans by a tower or gateway.

Professor Smith read a paper on "What City Planning Can Do for Wisconsin Cities." Prof. George R. Bascom, extension department, University of Wisconsin, has been studying the relation of street dust to disease through cultures taken and examined in various cities. He is of the opinion that dust is not nearly so injurious as is generally thought. However, Doctor Hanneke, State Board of Health, disagrees with this view, holding that the mechanical irritation of dust predisposes one to bacterial infection. The paper on monolithic brick pavements by W. T. Blackburn, was freely discussed because few, if any, pavements of this type have been laid in the state.

Front Cover Picture

The front cover picture of this issue shows a "hook-on" connection on a log flume now being built on Mica Creek, a tributary to the St. Joe River, Idaho. It was furnished by the contractor, Vincent K. Woods, of Missoula, Mont.

Engineers Qualify as Reserve Officers, U. S. Army

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Howard H. George, N. J.; Morgan T. Coakley, N. Y.; Raymond J. O'Brien, N. Y.; Harry T. Griswold, Conn.; G. August Schneider, Ind.; Jacob Schlessinger, Md.; Edward King Carley, N. J.; Earle P. Gray, Ohio; Albert F. Edel, N. Y.; Hugo C. Soest, N. Y.; James F. C. Hyde, Mich.; Julius R. Wemlinger, N. Y.

Second Lieutenants—Claude A. Latimer, N. Y.; Charles N. Bell, Pa.; Frederick W. Toerner, N. Y.; Ralph Eberlin, N. Y.; Francis E. Schanker, Pa.; Alexander W. Yereance, N. J.; Alexander X. Schroeter, Kan.; S. Dole Ashford, Conn.; F. Russell Lyons, Washington, D. C.; B. B. Anderson, Pa.; John H. Wilson, Washington, D. C.; Edward T. Collins, Conn.; William H. Griffith, Ohio; John M. Arovitch, Pa.; Samuel B. Balland, N. Y.; Frank C. C. Johnson, N. Y.; Merrifield G. Martling, Mo.; Paul J. Ploss, Pa.; Charles M. Anderson, N. Y.; Raymond P. Pennoyer, Pa.; George H. Schlotterer, Jr., N. J.; Harry B. Collins, Mass.; Walter P. Burn, N. Y.; John B. Cuno, N. Y.; Frederick U. Conard, N. Y.

Officers' Duties Outlined

With the list of names received from General Black was the following outline of the duties of reserve officers and qualifications for commissions:

In war operations, the engineer branch of the Army is required to furnish officers for duty, first, with the forces at the front and, second, on lines of communication in rear of the front, or for special services in other localities. The two services are co-ordinate and of equal importance, but for purposes of classification in the records, examining boards are required to recommend candidates for one class or the other. On account of the fact that the first class, designated Class A for convenience, will presumably be needed first for service with the mobile Army, candidates for the higher grades—that is, Captain or Major—are examined in military subjects. As there will be more time for the military training of the second class—Class B—no examination in military subjects is required. In actual service, those in Class B may be used for services usually required of Class A, and in commissions of officers no distinction is made.

Qualifications

The qualifications of engineers who are wanted for commission in the Engineer Officers' Reserve Corps, together with some of the duties required of them, are as follows:

(a) *Civil Engineers*—This class includes: General construction engineers, for the design, construction, and maintenance of earth and concrete fortifications, wharves, piers, and buildings of all kinds; highway engineers, for the layout, construction and maintenance of roads and trails on lines of communication or in other localities, including highway bridges of all kinds, ferries, fords, etc.; sanitary engineers, for the design, construction, maintenance and operation of waterworks, sewage-disposal plants, etc., in connection with camps or localities occupied by troops within the zone of operations; topographical engineers, for making maps of all kinds within the actual or probable zone of operations and the training of topographical units for the front, including all kinds of map reproduction, especially photolithography.

(b) *Electrical Engineers*—This class will be required for services such as the following: Design, construction, maintenance and operation of electric railways forming a part of the lines of communication, including the power plants connected therewith, the installation and operation of electric plants at seacoast fortifications and such power plants as may be needed on the lines of communication, the operation and maintenance of searchlights and other electrical equipment used in the protection of places on the lines of communication or other places not at seacoast fortifications, the training of troops in the care and operation of searchlights for the service at the front, the repair of searchlights and other electrical equipment used by troops at the front.

(c) *Railroad Engineers and Operating Officials*—This class requires all those engineers and operating officials ordinarily included in the organization of a commercial railroad system, including engineers for the location and construction of track, bridges, stations, etc.; engineers and officials for the maintenance of same, including wrecking operations; operating officials, such as general managers, superintendents, etc.

(d) *Mechanical Engineers*—This class will be required for such services as the installation and operation of machine shops for the maintenance and repair of railroad or other engineer equipment used on the lines of communication and for the design, maintenance and repair of engineer equipment used by the combatant troops at the front, including the field railways.

(e) *Mining Engineers* — This class will be required for such services as the construction of fortifications on the lines of communication or other places removed from the front, and in the training of troops for service at the front in sapping and mining operations, and in use of explosives.

Denver Engineers Survey State

A group of engineers of the Denver Civic and Commercial Association has undertaken a survey of Colorado's resources as to technical men and materials needed in military preparations. Prof. L. G. Carpenter, consulting engineer and chairman of the group, has announced a series of meetings to perfect plans.

Indiana Waterworks Men Discuss Problems

Aalyze New Business Methods, High Cost of Chemicals and Standard Fire-Hose Thread Changes

A part-payment method of getting new business, the high cost of chemicals and a demonstration of cutting standard hose threads on fire hydrants were features of the meeting, Feb. 14 and 15, of the Indiana Sanitary and Water Supply Association, held at Indianapolis. The registration roll reached 170.

R. A. Butler, publicity expert, and F. C. Jordan, secretary of the Indianapolis Water Company, made public for the first time a part-payment plan which the company has been investigating for several months. The method consists of the organization of a funding company, presumably as a subsidiary to the water company, for the purpose of financing the installation of sewer and water connections and plumbing fixtures for people of good credit but too poor to bear the immediate costs of such installations. The detail plans in common use by the gas and electric companies were favored. Although the field consists of the one-third of the whole population not now served by the water company, the scheme has more than local application, for this 30 per cent figure holds good as an average throughout the state, according to investigations of both the State Board of Health and the U. S. Public Health Service.

Advance in Purifying Chemicals

The chemical cost problem was presented in an instructive report by Philip Burgess, consulting engineer of Columbus, Ohio, who is chairman of the committee on water purification. From a questionnaire to the twenty-three plants in the state using chemicals, he learned that the average quantity of hypochlorite applied during 1916 was 8.5 lb. per million gallons, at a cost of 5.3 cents per pound. The average for liquid chlorine was 1.8 lb. at 16 cents per pound. Sulphate of iron costs, ranging from $10 to $24 per ton, have been determined largely by the price which the market would stand, being influenced largely by the increase in alum costs. Lime fluctuated less widely, $5.65 to $9.44 per ton being the cost for hydrated lime. At Columbus, Ohio, C. P. Hoover is manufacturing alum for the water purification plant. The cost was $7.20 per ton in 1915, but in 1916 the high price of acid raised the figure to $20.08.

Development of dry-feed machines for the application of chemicals is progressing rapidly, Mr. Burgess stated, especially in plants using lime and iron. A satisfactory type is a helical conveyor in the bottom of a hopper. He stated that a 4-in. conveyor would discharge daily 3000 lb. of sulphate of iron or 1000 lb. of hydrated lime when operated at 1 r.p.m.

The thread-cutting demonstration was staged in front of the water company's office, an ordinary hydrant nipple of eight threads to the inch being chased down so that a standard 7½-thread coupling would fit. A fireman who was present was not entirely satisfied with the demonstration, for the coupling chattered while being put in place. However, a test of 500 lb. per square inch which broke the hose failed to blow off the connection. It was stated that old nipples could be chased down at a cost of 30 cents apiece, while new nipples would cost several times as much. The demonstration was doubly interesting in view of the fact that a bill at present before the state legislature requires every connection to be made standard.

Want Standard Fire-Hose Couplings

J. B. Marvin, superintendent of waterworks, Frankfort, in his paper on fire-fighting methods in Indiana, called special attention to a recent disastrous fire at New Castle, at which hose brought in from Muncie was useless on account of the non-conformity of threads in the couplings. Of the 210 water systems in the state, it was computed that 95 per cent could be adapted to take standard couplings without change. Paul Hansen, chief engineer, Illinois State Board of Health, presented a paper on the practical aspects of State control of water supply and sewage disposal. Three fundamental considerations were laid down: get the maximum amount of health and sanitation possible from money spent; distribute expenditures equitably over the State; give local governments and agencies the maximum latitude possible in meeting their own problems in their own way, consistent with the welfare of the State as a whole.

Round-Table Discussions

Four round-table discussions were held, each being restricted to one hour. F. C. Jordan presided over the one on surreptitious use of water. Dow R. Gwinn called it plain stealing, and laid particular stress on illicit tapping of private fire lines. William Luscombe, of Gary, in leading the discussion on meter-department operation, stated that a special man was employed to notify consumers of excess meter reading. A handbill, warning patrons to care for the meter in cold weather, is sent out with December bills. It costs 0.2 cent to deliver bills, but gas and electric bills are sent by the same man.

Uses Post-Card Water Bills

"In Indianapolis," said W. G. Ulrich, "there are 5000 meters out of 38,000 connections in an area of 90 sq. miles. It requires five readers eight days to make readings. If the reading is high, the reader takes time to go over the fixtures. The postal-card bill is used and a stub is cut, the receipt end being returned in a 2-cent envelope. Postal regulations are observed as to size in sending out bills in 1-cent envelopes." J. A. Craven, Terre Haute, outlined a scheme of rivalry by which the readers of the thirty-five meter books are spurred on to reduce the time of readings.

The officers elected for the coming year are as follows: President, W. F. King; vice-presidents, J. W. Toyne, A. L. Fields, R. B. Wiley, Philip Burgess and Howard Ely; secretary-treasurer, W. G. Ulrich, Indianapolis, assisted by J. A. Craven.

Iowa Engineers Adopt Minimum Standard Fees

Proposed Engineering License Bill Segregates Classes and Exacts Merely Nominal Fee

Standard minimum fees to be charged clients for professional services were adopted by the Iowa Engineering Society at its meeting Feb. 21, 22 and 23 at Ames. A per diem rate of $25 and expenses was held proper for consultation. Municipal engineering is held to be handled best on a percentage basis. Including inspection, engineers should charge at least 5 per cent for paving, 8½ per cent for sewers and 6 per cent for water and light plants.

Fees Are Graded to Service

J. H. Mayne, consulting engineer, Council Bluffs, as chairman of the committee on professional ethics and standard fees, brought in the report containing these standards. The fees were named mainly for the guidance of official bodies when considering the employment of an engineer. For services of a preliminary nature, including estimates, reports, etc., 1½ per cent of the cost is to be the minimum. If there is also included the preparation of the drawings, specifications and contract, and all work up to the letting of the contract, 2½ per cent is to be charged. If the engineer is asked to go still further and handle the letting of the contract and have consulting supervision of the work, then 5 per cent is to be received; while if he goes still further and takes full responsibility for the inspection and construction, including all engineering, the cost is to be 6 per cent.

Charles P. Chase, in discussion, succeeded in raising the figure for sewers from 7 per cent to 8½ per cent. In his twenty-five years' experience he has found in many cases that the former figure would leave no margin of profit.

For a License Bill

In the license bill which the committee on that subject, headed by T. S. DeLay, was authorized to present to the present legislature, civil engineers or surveyors must be licensed, for the branch of the profession under which their practice is classified, by a state board of three examiners to be appointed by the governor from a list furnished by the Iowa Engineering Society. The board is to be sustained from the fees collected from engineers. A secretary at $3000 per year is provided, the board members to receive $10 per day and expenses for the time actually spent. License money is to be held as a separate fund, and the total amount of the warrants must not exceed the fees paid in. After the first year all candidates are to pay $10, but for the first year after the enactment of the bill those actively engaged in engineering for at least five years and in responsible charge for one year may be given licenses on payment of $3. The license will permit practice in any one or more branches of engineering which the record of their experience shall indicate they have qualifications. Engineers may acquire the right to practise in additional branches by the payment of an additional $3 and by submitting satisfactory proof of ability. An annual renewal fee of $1 is to be exacted. Punishment for violation of the act consists of fines of from $100 to $500, or imprisonment for three months, or both.

Charles P. Chase, in his talk on "Co-operation of Engineers in Iowa," held that the society secretary ought to maintain a service clearing house for employer and employee. The consulting engineer frequently has a hard time keeping his men over winter, and he felt that probably some one else might need and be able to use such men.

Unionism Up to Employing Engineers

The "continuity of service" problem was touched upon again by H. J. Burt, president of the Western Society of Engineers, who gave the banquet address on "The Engineer of To-day." He held that the responsibility for its solution rests on the employing engineers and that it would be most unfortunate if the principles of unionism should be invoked by a set of employees from whose ranks are to be taken men for positions requiring the utmost fidelity. As unionism has already started in Chicago, he cautioned his hearers to think it over and to consider whether they were doing their part to prevent its spread.

Prof. A. W. Hixson, Iowa State University, presented the results of a series of experiments showing the detrimental effect of overheating asphalt both as to physical and chemical properties.

The officers elected for the coming year are as follows: President, Keyes C. Gaynor; vice-president, C. T. Wilson; secretary-treasurer, J. H. Dunlap, Iowa City; directors, C. H. Currie and H. H. Dean.

Begin Work on Sixth Au Sable Hydro-Electric Plant

The sixth hydro-electric development plant on the Au Sable River has been started by the Commonwealth Power, Railway & Light Company. This plant will have a capacity of about 11,000 horsepower. The Commonwealth's fifth hydro-electric plant on the Au Sable, known as the Foote development, is now in the process of construction, and will have a capacity of 12,000 horsepower. The sixth of the Au Sable plants will be completed by the end of the present year.

Military Training Urged Upon Engineers

The desirability and necessity of compulsory universal military training is being urged upon the members of the five national engineering societies by a printed folder signed by sixteen of the nation's most famous engineers. The folder, which is addressed to the members of the American Society of Civil Engineers, American Institute of Mining Engineers, American Society of Mechanical Engineers, American Institute of Electrical Engineers, and American Institute of Consulting Engineers, says in part:

"We know most engineers realize that compulsory training and service are not only desirable but absolutely necessary for the welfare and safety of our country. We feel sure that those of you who are not already firmly of that conviction will become so after having given the subject a little careful thought.

"Believing that all of you are not only ready but anxious to render such service to our country as lies within your power, the undersigned earnestly request that each of you send personal letters, or telegrams, to the Representative from your district, and to each of the two Senators from your State, to the following effect, but preferably in your own language:

"I urgently request you to support and vote for the plan covered by Senate Bill S-1695, reported by Senator Chamberlain Feb. 10, 1917, providing for compulsory military and naval training and service; preferably with such modification of it as may be recommended by the General Staff of the Army, and the General Board of the Navy." The folder gives the essential features of the bill in brief form.

The following signers, although members of one or more of the societies addressed, act as individuals in making the request: Bion J. Arnold, W. F. Durand, Thomas A. Edison, J. D. Galloway, George W. Goethals, W. F. M. Goss, Alexander C. Humphreys, A. M. Hunt, E. C. Jones, W. S. Lee, Ralph D. Mershon, William Barclay Parsons, M. I. Pupin, Charles F. Rand, J. Waldo Smith, John F. Stevens, L. B. Stillwell, George F. Swain, W. H. Wiley and W. J. Wilgus.

New Jersey Proposes State Highway Commission

A bill to be introduced in the New Jersey legislature provides for a State Highway Commission consisting of eight men, to replace the present commissioner. These men will serve without compensation and will appoint the State Highway Engineer, who will have complete charge of administering the department. The present plan is to ignore the Egan Bill, which provides for a $7,000,000 bond issue, and to pass another bill providing for the levy of a special tax for road purposes.

The bill proposes to raise $3,000,000 a year for a period of five years. In addition to this, automobile license fees and fines will be spent on repairs and reconstruction. This means that about $25,000,000 will be spent on New Jersey roads in the next five years if the proposed measure goes through. The work will be done by the State Highway Department and not by individual counties as at present.

Water Power Bill Revived in Congress

The House of Representatives has rescinded its action of last week when it voted to discharge its conferees on the general dam bill upon which they had reported, since there seemed no chance of an agreement between the House and Senate.

President Wilson and Representative Adamson have had a number of conferences on the bill, and President Wilson has favored water-power legislation at this session of Congress. The result of the rescinding of the House action means that there will be another attempt of the Senate and House conferees to get together on the bill, as the Senate did not discharge its conferees when they reported no agreement.

The general dam bill, in different forms, passed both houses of Congress at the last session. There is now a prospect that the bill will be passed at this session of Congress.

Engineers Entertain Concrete Institute

With co-operation as its watchword, the American Association of Engineers tendered a banquet to the American Concrete Institute last week. From the time the coffee-cups were pushed back and cigars lighted to the end of the program not an uninteresting minute passed. Presided over by W. H. Finley, chief engineer of the Chicago & Northwestern Railway, and with Richard Henry Little of the Chicago *Herald* as toastmaster, each of the seven speakers held the attention of the listeners without difficulty. Walter L. Fisher, former Secretary of the Interior, gave a masterly exposition of the nature of the League to Enforce Peace.

Delayed Blast Causes Fatal Accident in Twin Peaks Tunnel

A gang of workmen engaged in blasting rock in the Twin Peaks tunnel at San Francisco returned to work after a round of shots had been fired on Feb. 15 and were caught by a delayed explosion. Twelve charges had been placed, the fuses ignited, and from a place of safety the shots were counted as they exploded. One missed fire, but was lost in the count, it being taken for granted that it had exploded simultaneously with one of the other shots. After the usual wait, the gang returned to work, and just as they reached the spot the delayed explosion occurred, killing the foreman and one laborer, seriously injuring two, and causing lesser injuries to five others.

What Engineers and Contractors Are Doing

B. F. Cresson, Jr., retired March 1 as chief engineer of the New Jersey State Board of Commerce and Navigation and became consulting engineer to the board. Mr. Cresson proposes to enter private practice as a consulting engineer, with offices at 50 Church Street, New York City. Until May 1, however, his temporary offices are 30 Church Street.

Waddell & Son, consulting engineers, Kansas City, Mo., have opened a branch office in the City Investing Building, 165 Broadway, New York City. Mr. F. H. Frankland, as noted in last week's issue of the Engineering Record, will be in charge of the office. Dr. Waddell will divide his time between the two offices.

W. A. Bouve is at present engineer for the General Chemical Company at the Bay Point plant, Bay Point, Cal. For the last year Mr. Bouve has been construction engineer with the Associated Pipe Line Company in charge of construction of two oil-pumping stations on the line from Bakersfield to Porta Costa. Previous to 1916 he was employed by the Southern Pacific Company as field assistant for one year, by the Associated Oil & Pipe Line Companies as draftsman, computer and foreman, for two and one-half years, and by private engineers as computer and transitman on subdivision and sewer work for a period of two and one-half years. His experience in the last four years has been mainly factory construction work.

H. C. Vensano announces his resignation as civil and hydraulic engineer of the Pacific Gas & Electric Company and his association with John R. and Edward G. Cahill, general contractors, under the firm name of Cahill-Vensano Company, contracting engineers, 460 Montgomery Street, San Francisco, Cal.

Robert C. Wheeler, city engineer, Summit, N. J., has resigned.

Marc P. Taylor has been appointed resident engineer at Madison, Mo., for the Chicago, Burlington & Quincy Railroad. Since graduation from the University of Illinois, in 1913, Mr. Taylor has been in private work and also in the employ of the railroad at the Chicago offices.

Robert Gaw, North Bergen, N. J., has been appointed engineer for the Boulevard Commission, Jersey City, N. J., to supervise all work in connection with the Hudson County Boulevard, succeeding Frederick Dunham.

Fred E. Wilson has been appointed city engineer of Marion, Ind. Mr. Wilson, who is a graduate of Purdue, has had five years' experience in construction and maintenance work with the Northern Pacific Railway and the Chicago, Milwaukee & St. Paul Railway.

Paul P. Whitham, consulting engineer, Seattle, Wash., has been appointed federal trade commissioner to investigate port and transportation facilities in Russia and the Far East. Mr. Whitham was chosen commissioner out of several hundred applicants from all parts of the United States. After successfully passing a series of examinations he was selected as one of a group of fifteen engineers to go to Washington, D. C., and take the final examination. In this test he ranked the highest and was awarded the post. In line with the development of the foreign trade of the United States in the Far East Mr. Whitham is to make a careful survey of conditions and submit a report to the Bureau of Foreign and Domestic Commerce on his findings. The tenure of his office is indefinite. Mr. Whitham, who was formerly chief engineer of the Port Commission of Seattle, resigned about two years ago to enter private practice. During his connection with the Port of Seattle he took a leading part in designing Seattle's new port facilities, and is regarded as one of the most capable port engineers of the country.

Appointed Federal Trade Commissioner

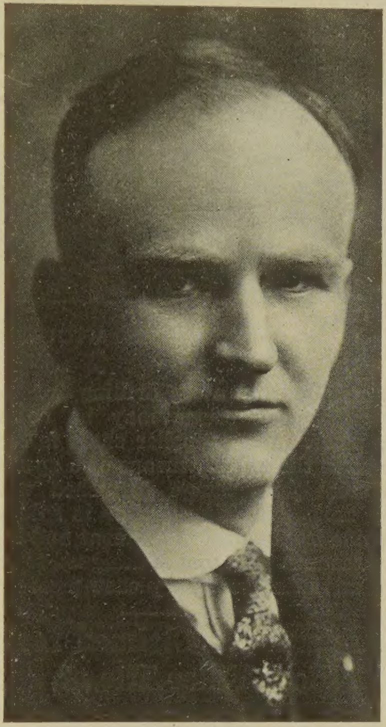


Photo Merrihew Studio, Seattle, Wash.

PAUL P. WHITHAM

Rourke & Sherman, consulting engineers, Boston, Mass., have dissolved partnership.

John A. Barhite, of Rochester, N. Y., has been appointed a member of the New York State Public Service Commission, Second District, in place of D. P. Hodson. Mr. Barhite has been a county judge for eleven years.

John Roberts has been appointed borough manager and engineer for Bristol, Pa., effective Feb. 1.

The following appointments for members of the Delaware River Bridge and Tunnel Commission have been made by Governor Edge of New Jersey; Thomas J. S. Barlow, Burlington, reappointed; R. T. Collins, Camden, succeeding Issac M. Griscom, and Daniel F. Hendrickson, Gloucester, succeeding C. R. Budd.

F. Van Z. Lane, executive engineer and traffic expert for the city of Bayonne, N. J., has resigned to accept an appointment as manager for the Jersey City Chamber of Commerce.

W. O. Hands, for twenty-three years in the civil engineering department of the Kansas City Railways Company, has opened an office in the R. A. Long Building, Kansas City, Mo., where he will conduct a general engineering practice.

S. L. Miller has left the employ of the Illinois Highway Department at Springfield, Ill., and is at present engaged on pier-protection construction work for the Wabash Railroad at Hannibal, Mo. Mr. Miller may be addressed at Box 25, Hannibal, Mo.

L. D. Howland is construction engineer with the Great Western Electro-Chemical Company at Pittsburg, Cal. Prior to his present position, Mr. Howland was for three years with the State Water Board of Oregon as division engineer and for two years was county engineer of Union County Ore. Mr. Howland is at present connected with the enlargement of the $400,000 plant of the Great Western Electro-Chemical Company.

John T. Gephart, Jr., formerly construction engineer of the Pennsylvania State Highway Department, has been appointed road engineer for Fayette County, Pennsylvania.

J. F. Greene has resigned his position as bridge engineer in charge of the design and construction of the Centre Street Bridge, Calgary, Alta., Canada, and has entered the employ of the Carter-Halls-Aldinger Company, Ltd., engineers and builders, Union Bank Building, Winnipeg, Canada, where he is in charge of the underpinning of the Grain Exchange Building in Winnipeg. Prior to entering the employ of the city of Calgary as bridge engineer in 1914, Mr. Greene was bridge engineer for the city of Spokane, Wash. While in this position he had charge of the design and construction of the Monroe Street concrete bridge costing $500,000.

H. P. Niles, engineer Drainage District No. 5, Snohomish County, Washington, has resigned his position.

John R. Donaldson is now located in the bridge office of the Illinois Central Railroad. Since graduation from the University of Illinois in 1916 he has been employed as assistant in the office of the County Superintendent of Highways at Urbana, Ill.

BRADFORD-ACKERMANN CORPORATION, with offices in the Forty-Second Street Building, New York City, is announced by A. H. Ackermann, formerly vice-president and general manager of the U. S. Light & Heat Corporation, and C. C. Bradford, formerly sales manager of the same company. The new firm will represent manufacturers of electric apparatus, factory, automobile and railway supplies for domestic and export trade. Correspondence with reliable manufacturers is invited.

E. J. COOK, general manager of the New York State Railways, Rochester lines, has been appointed chief engineer of all lines of this system, which include the city lines in Rochester, Syracuse, Utica and Schenectady, the third-rail line between Syracuse and Utica, and half of the interurban line between Schenectady and Albany.

Obituary Notes

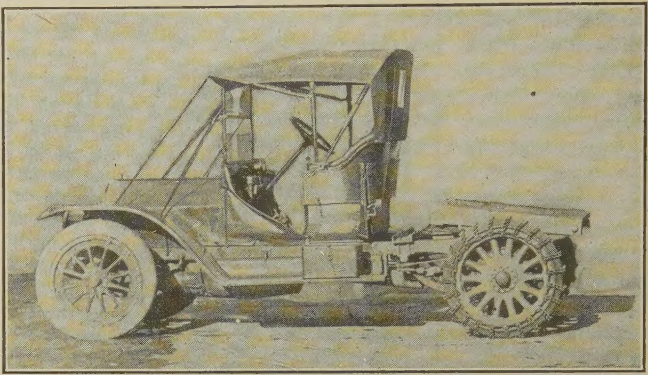
WILLIAM E. HAMLIN, civil engineer, said to have been one of the four or five men who submitted bids for constructing the Panama Canal, died Feb. 13 in Pasadena, Cal., where he had resided during the last five years. He was 44 years of age. Mr. Hamlin was born in Boston and attended Massachusetts Institute of Technology. From 1893 to 1898 he was in charge of city surveys for the Boston Water Department and of tidal observation and triangulation work. Later he constructed different roads and sewers and was engaged on pile and foundation construction. In 1902 he went to Venice, Italy, to estimate the cost of rebuilding the Campanile tower and to make a study of the Italian cement industry. In 1903 he was with F. B. Gilbreth, engineer, contractor and manufacturer, as chief civil engineer in charge of the New York office. Later he forsook contracting and engineering pursuits and went to California to develop and manage his property there, where he was owner of a large tract of land near Red Bluff.

GEORGE ROSS, senior partner of the Ross Valve Manufacturing Company, died Feb. 9 at the age of 88 years.

WILLIAM O. HENDERER, president of the Osborn Engineering Company, Cleveland, Ohio, died Feb. 8 at Miami, Fla. Mr. Henderer had been connected with the company since 1897, and up to 1900 was in direct charge of design of viaducts, bridges and buildings and of the inspection of bridges for six different railroads. Later he was active as vice-president and director of the company, and still later as its president. Mr. Henderer studied at Rensselaer Polytechnic Institute and up to the time of his association with the Osborn Engineering Company enjoyed a general engineering practice in design, fabrication and erection of many steel and concrete structures, among them the Brooklyn-Brighton viaduct.

Design Three-Ton Tractor Unit

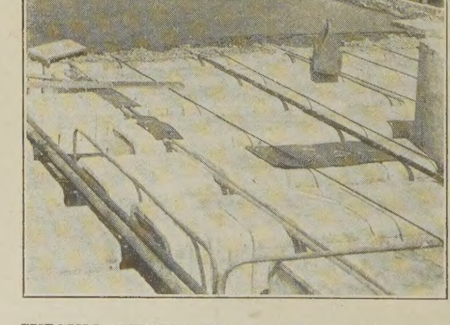
A tractor unit which may be used with a dismantled pleasure car to produce a 3-ton tractor has recently been put on the market by the Knox Motors Associates, Springfield, Mass. The new unit, which is sold at $550, is attached by first stripping the body from the rear as far forward as the back of the front seat and removing the rear axle and springs. The cross-channel of the traction unit is placed over the stripped frame, which may be of any width, is squared up, and after drilling for the necessary connections may be bolted into place. The propeller shaft is connected to the axle by means of a special universal joint flange furnished with each unit. The new tractor is said to combine low capital investment and low maintenance cost, and is designed to afford an outlet for used pleasure cars.



TRACTOR UNIT USED WITH DISMANTLED CAR

Advantages Claimed for Floor Filler Tile of Gypsum

Filler tiles of gypsum for use in constructing concrete floors have recently been put on the market. The tiles are hollow, having reinforced walls 1 in. thick at the sides and ¾ in. thick at top and bottom. The top edges are rounded to eliminate sharp corners at the junction of floor and T-beams. A spacer of gypsum, 1 in. thick, is used between tiles at joists. This aligns the tile and also prevents the concrete from coming in direct contact with the forms. Thus the tiles are 1 in. deeper than the concrete joists, and an all-gypsum ceiling surface is left after the forms are removed.



GYPSUM FILLER TILES ARE EASILY CUT FOR PIPES

Some of the claims made for the tile by the maker, the U. S. Gypsum Company, are as follows: They are sufficiently strong for wheeling and similar working operations which must be conducted over the tile during the pouring of concrete, since a 6-in. tile under test carried a load equivalent to 664 lb. per square foot. This strength makes possible a thinner concrete floor slab. As the ends are closed and the sides fit closely, there is no appreciable waste of concrete. Form work is reduced to a minimum. Holes for piping and conduits are easily bored or cut in the tiles, and in 12-in. joists there is a saving in the "dead load" of 20 lb. per square foot. A material increase in the strength of the concrete is claimed since the gypsum prevents it from drying out too quickly. Concrete set in contact with a wetted tile gave crushing-strength values at 7, 28 and 90 days of respectively 16, 17 and 40 per cent in excess of concrete set without floor tile. The tiles are made of Structolite gypsum, which is not weakened by exposure to the elements during construction.

The manufacturer of this tile has been developing the uses to which gypsum can be put. Several of its products are well known and have met with a favorable reception, among them a reinforced tile roof deck for which they claim a combination of unusual lightness and adequate strength.

Building Methods and Materials on Exhibition

From March 5 to March 11 inclusive the Second National Complete Building Exposition will occupy the Grand Central Palace, New York City. Here the manufacturer, architect, contractor and prospective builder will get together for the exchange of ideas and to get acquainted at first hand with the recent developments in construction methods and materials. Extensive exhibits of structural steel, cement products, brick, architectural and structural terra cotta, limestone, marble and lumber have been planned by the various dealers and manufacturers, and there will be shown examples of special types of construction, fire-resisting metal window frames and sash, wire glass, expanded metal products, partition construction, ventilating and plumbing systems, elevator installations, and the better forms of construction toward which public sentiment is so rapidly turning.